Reference
NBS Publi-cations
A11101 729815
NAT'L INST. OF STAND & TECH R.I.C.
A11105 102116

NBSIR 80-2014

Safe Environments--Anthropometric, Biomechanical, and Activity Considerations

Clarke E. Jones
John V. Fechter

Consumer Sciences Division
Center for Consumer Product Technology
National Bureau of Standards
U.S. Department of Commerce
Washington, D.C. 20234

September 1979

Issued June 1980
Final Report

Prepared for the
Center for Fire Research
National Bureau of Standards, in support of:
HEW-NBS Fire/Life Safety Program

Sponsored by:
Rehabilitation Services Administration, Office of Human Development Services
Department of Health, Education and Welfare
Washington, D.C. 20203

QC
100
.U56
80-2014
1980

NATIONAL BUREAU
OF STANDARDS
LIBRARY
JUL 23 1980
Not acc Ref
QC100
.U56
80-2014
1980

NBSIR 80-2014

SAFE ENVIRONMENTS--ANTHROPOMETRIC, BIOMECHANICAL, AND ACTIVITY CONSIDERATIONS

Clarke E. Jones
John V. Fechter

Consumer Sciences Division
Center for Consumer Product Technology
National Bureau of Standards
U.S. Department of Commerce
Washington, D.C. 20234

September 1979

Issued June 1980
Final Report

Prepared for the
Center for Fire Research
National Bureau of Standards, in support of:
HEW-NBS Fire/Life Safety Program

Sponsored by:
Rehabilitation Services Administration, Office of Human Development Services
Department of Health, Education and Welfare
Washington, D.C. 20203

U.S. DEPARTMENT OF COMMERCE, Philip M. Klutznick, *Secretary*

Luther H. Hodges, Jr., *Deputy Secretary*
Jordan J. Baruch, *Assistant Secretary for Productivity, Technology, and Innovation*

NATIONAL BUREAU OF STANDARDS, Ernest Ambler, *Director*

Table of Contents

	Page
Acknowledgments	vi
Abstract	viii
Introduction	1
Anthropometry and Biomechanics	2
Household Safety	7
Disability	9
Household Operations	10
Summary and Conclusions	12
Illustrated Glossary of Selected Anthropometric and Biomechanical Measurements	14
List of Tables	ii
Bibliography	123
Appendix A--Organizations of the Disabled Contacted for this Report	136

List of Tables

		Page
1	Anthropometric Data Summary - Height	27
2	Anthropometric Data Summary - Reach	29
3	Anthropometric Data Summary - Whole Body Position	31
4	Anthropometric Data Summary - Wheelchair and Occupant	33
5	Anthropometric Data Summary - Normal Routine Passage Requirements	34
6	Anthropometric Data Summary - Ambulant Disabled Space Requirements	35
7	Anthropometric Data Summary - Wheelchair Dimensions.	36
8	Anthropometric Data Summary - Wheelchair Maneuvering Space Requirements	37
9	Biomechanics Data Summary - Grasp Reach Range	39
10	Biomechanics Data Summary - Reach Envelope, Amputees	40
11	Biomechanics Data Summary - Range of Joint Motion	41
12	Biomechanics, Motor Performance Data Summary - Hand/Arm Manipulation	43
13	Biomechanics, Motor Performance Data Summary - Blind	44
14	Biomechanic Motor Performance Data Summary - Plegic Dexterity	45
15	Biomechanics, Motor Performance Data Summary - Walking	46
16	Biomechanics Data Summary - Grip Strength	47
17	Biomechanics Data Summary - Push-Pull	48
18	Biomechanics Data Summary - Whole Body Push	51
19	Biomechanics Data Summary - Safe Manual Force Application	53
20	Biomechanics Data Summary - Lifting, User Acceptance	62
21	Home Safety Data Summary - Accident Background - Personal Factors	67

List of Tables (Continued)

		Page
22	Home Safety Data Summary - Accident Background - Exercise Level	70
23	Home Safety Data Summary - Accident Backgound - Product Quality	71
24	Home Safety Data Summary - Accident Background - Tobacco	73
25	Home Safety Data Summary - Accident Background - Alcohol Consumption, Background	74
26	Home Safety Data Summary - Accident Background - Alcohol Use	75
27	Home Safety Data Summary - Accident Background - Alcohol Consumption, Injury	76
28	Home Safety Data Summary - Accident Background - Drug Availability	77
29	Home Safety Data Summary - Accident Background - Type Medication Error Factor	78
30	Home Safety Data Summary - Accident Background - Accident Site of Falls	79
31	Home Safety Data Summary - Accident Background - In-Home Location	80
32	Home Safety Data Summary - Accident Background - Fixtures, Frequency	81
33	Home Safety Data Summary - Accident Background - Fixtures, Severity	82
34	Home Safety Data Summary - Accident Background - Floor Surface Effect in Falls	83
35	Home Safety Data Summary - Accident Background - Processes of Falls	84
36	Home Safety Data Summary - Accident Background - Immediate Causes of Falls	85
37	Home Safety Data Summary - Accident Background - Fire Mortality	86

List of Tables (Continued)

		Page
38	Home Safety Data Summary - Accident Background - Burn Hazards	87
39	Home Safety Data Summary - Accident Background - Pre-Existent Factors in Burns	88
40	Home Safety Design Recommendations Summary - Check Lists	89
41	Home Safety Design Recommendations - Kitchen Illumination	95
42	Home Safety Design Recommendations Summary - Area Illumination	96
43	Disability Data Summary - General	98
44	Disability Data Summary - General Motor	99
45	Disability Data Summary - Deafness, Prevalence	100
46	Disability Data Summary - Deafness, Level	101
47	Disability Data Summary - Other	102
48	Household Activity Data Summary - Activity Time - Housewives Time	109
49	Household Activity Data Summary - Activity Time - Housework Time Variation	110
50	Household Activity Data Summary - Activity Time - Meal Preparation	112
51	Household Activity Data Summary - Child Care Time	113
52	Household Activity Data Summary - Personal Time	114
53	Household Activity Data Summary - Activity Times - Free Time	115
54	Household Activity Data Summary - Equipment Utilization - Heating and Cooling	116
55	Household Activity Data Summary - Equipment Utilization - Kitchen Equipment	117

List of Tables (Continued)

		Page
56	Household Activity Data Summary - Equipment Utilization - Clothing Care	118
57	Household Activity Data Summary - Task Difficulty Factors - Cognitive	119
58	Household Activity Data Summary - Task Difficulty Factors - Work Constraint	120
59	Household Activity Data Summary - Task Difficulty Factors - Housing and Equipment	121
60	Household Activity Data Summary - Task Difficulty Factors - Complexity, Difficulty, Preference	122

Acknowledgements

The preparation of this report required permission to present copyrighted material from a wide variety of publications. The cooperation of publishers and authors in granting this permission is gratefully acknowledged for the following tables of this report, with sources of data as indicated.

Table 12 utilizes data from Kvalseth, T.O. Comparison Between Information Rates Generated by Rotary Hand and Arm Movements. Perceptual and Motor Skills. 1976, 42, 1115-1118, Figure 1 and Table 1, reprinted with the permission of the author and Perceptual and Motor Skills.

Table 13 utilizes data from Elfant, E.E. Correlation Between Kinesthetic Discrimination and Manual Dexterity. American Journal of Occupational Therapy Vol. 33, No., 1, pp 23-28, Table 1, p. 25, reprinted with the permission of the American Occupational Therapy Association, Inc., Copyright 1977.

Table 14 utilizes data from Bell, E., Jurek, K. and Wilson, O.T.R. Handskill Measurement, A Gauge for Treatment, The American Journalof Occupational Therapy. Vol. 30, No. 2, pp 80-86, Figure 1, p. 82, reprinted with the permission of the American Occupational Therapy Association, Inc., Copyright 1976.

Table 15 utilizes data from Finley, F.R., Cody, K.A., and Finizie R. V. Locomotion Patterns in Elderly Women. Archives of Physical Medicine and Rehabilitation, March 1969, pp. 140-146, Table 2 and text quote, p. 143, reprinted with the permission of Archives of Physical Medicine and Rehabilitation.

Table 19 includes data and figures from papers by R. R. Davis and D. A. Stubbs, Safe Levels of Manual Forces by Young Males (1) and (2), which appeared in Volume 8, pp 140-150 and 219-228 of Applied Ergonomics, published by IPC Science and Technology Press Ltd., Guildford, Surrey, U.K.

Table 21 utilizes data from Guilford, J. S. Prediction of Accidents in a Standardized Home Environment. Journal of Applied Psychology, 1973, Vol. 37, No. 3, pp 306-313, Table 2, p. 310, and Table 3, p. 311, Copyright 1973 by the American Psychological Association, reprinted by permission of the American Psychological Association and the author.

Tables 22, 23, 24, 26, and 28 utilize data from Tokuhata, G.K. et al. Consumer Behavior and Product Injuries. Journal of Safety Research 1976, Vol. 8, pp 116-125, Tables 1, 4, 9, 10, 11, reproduced by permission of the National Safety Council.

Table 29 utilizes data from Neely E. and Patrick, M. L. Problems of Aged Persons Taking Medications at Home. Nursing Research, 1968, Vol. 17, pp 32-35, Tables 1, 2 and 3. Copyright 1968, American Journal of Nursing Company reproduced with permission from Nursing Research, January-February, Vol. 17, No. 1.

Tables 30, 34, 35, and 36 utilize data from Lucht, U. A Prospective Study of Accidental Falls and Resulting Injuries Among Elderly People, Acta Socio-Medica Scandinavia, 1971, Vol. 2, pp 105-120, Tables 3, 4, 5 and 6 reproduced with permission of Almqvist Et Wiksell International.

Table 42 utilizes data from Corwin Bennett, Spaces for People: Human Factors in Design, Copyright 1977, pp 94, Table 6.1, reprinted by permission of Prentice-Hall, Inc. Englewood Cliffs, New Jersey.

Table 43 utilizes data from Templar J. and Jones, M. Pedestrian Mobility: The Accessible City in Bednar, M. J. Barrier Free Environments, Table 2.2, p. 22, reprinted with permission of Dowden, Hutchinson and Ross.

Tables 50, 54, 55 and 56 utilize data from Walker, K.E. and Woods, M.E. Time Use: A Measure of Household Production of Family Goods and Services, Tables 4.11, 4.13, 6.12 and 7.7, Copyright 1977 by American Home Economics Association, reprinted by permission of American Home Economics Association.

Tables 57, 58, 59 and 60 utilize data from Steidl, R.E. Difficulty Factors in Home Making Tasks, Implications for Environmental Design. Human Factors, 1972, Vol. 14, No. 5 pp 471-482, Tables 1, 2, 3 and 4, Copyright 1972 by the Human Factors Society and reproduced by permission.

ABSTRACT

This report has been prepared for the National Bureau of Standards' Center for Fire Research as part of their support for the Office of Human Development Services of the U.S. Department of Health, Education, and Welfare. The purpose of this report is to present a cataloque of data on a "normal" home including certain characteristics of its able-bodied and disabled residents, the activities carried out and basic criteria for household design. This represents an environment in which the disabled should be able to safety function in a non-institutional setting. The report summarizes selected data pertaining to the physical characteristics of "normal" and disabled people, the spaces within which they move, their limits of bodily action, the causes of their injuries in the home and their use of residential time. Specific and general evaluations of the applicability of the data to normal home activities are presented.

Safe Environments--Anthropometric, Biomechanical and Activity Considerations

1.0 Introduction

The safety of people in a home environment can be promoted by studying their body dimensions, the space through which they move, their limitations, their use of time, and the causes of their injuries.

This report focuses on people living in "normal homes" and the activities performed within those homes. For this report, a "normal home" is one not specifically established to accomodate the disabled, although disabled people may certainly be residents of normal homes. Some data about disabilities are also included to show the type of handicaps and limitations that may be found among residents of homes for the developmentally disabled.

Data summaries are organized into four sections: Anthropometry and Biomechanics, Household Safety, Disability, and Household Operations.

The data are those that were considered to be the most relevant in creating a safe environment. As an example, in setting standards for emergency exit doors it is important to know the dimensions of people and the push forces they can exert on a panic door latch. Another example--knowing how people spend their time in the house can provide an index of exposure to hazards.

The information about the use of time and rooms in normal homes can be used to compare normal homes to those established for the disabled. This would assist in evaluating the level of home safety achievable for residents of a home for the disabled. The information would also be helpful for creating a normal home environment in homes for the disabled.

The data have been obtained almost entirely by literature search, using computerized sources such as the Smithsonian Science Information Exchange, Educational Resources Information Center, Psychological Abstracts, MEDLINE, NTIS, Dissertation Abstracts and other references. Most data on disabilities were obtained directly from national associations for the disabled.

In some cases, data have been included because they were the best or only data available. More work is needed to collect more and better ergonomics data.

The data are extremely diverse in origin, format, and content and cover a wide range of study approaches. Those differences are noted and discussed where they limit the applicability of the data.

2.0 Anthropometry and Biomechanics

Anthropometry and biomechanics are the study of body measurements and movements and force capabilities of people. The data tables for this section cover:

Categories	Tables
• Basic body dimensions	1 through 4
• Maneuvering space requirements	5 through 8
• Motion envelopes	9 through 11
• Dexterity	12 through 15
• Muscular strength	16 through 20

Measurement points not illustrated in a table or otherwise defined are illustrated in the Glossary.

Basic body dimension tables (1 through 4) describe how the human body occupies space. Table 4 also illustrates the change in that occupied space when the person is in a wheelchair. For example, vertical reach is restricted for wheelchair occupants.

Because anthropometric measurement techniques may vary from one study to another, differences in measurement data may reflect data collection procedures as well as real differences between populations. The worst case of procedural difference is probably for the children's data in Table 4, which were not originally collected from subjects in wheelchairs.

On the whole, the most reliable anthropometric data come from recent military studies. The least reliable, due to age of data and unknown study factors are probably from the early studies cited in Van Cott and Kinkade (69) and the children's wheelchair data from Goldsmith (23). The extent to which a study's methodological limitations affect the usefulness of any of these data depends upon the desired level of precision. Such methodological limitations should not cause serious problems for home applications because dimensional interaction between occupants and space in a normal home is seldom "tight," except for wheelchair occupants.

Tables 5 through 8 describe the maneuvering space needed for people whose walking ability is unimpaired, and the space needed for "crippled ambulants" or wheelchair occupants. Table 7 is a reference table of wheelchair dimensions. The data in Tables 7 and 8 do not fully apply to attendant-propelled or motorized chairs. While the reliability of the data in Table 8 is difficult to assess, the measurement requirements for their utilization are generally not rigorous, although some of the wheelchair-maneuvering space requirements are rather complex, e.g. turning through a door.

In general:

1. A passage 90 cm wide, straight or L-shape, will allow minimally adequate space for a wheelchair or for an ambulant individual with shoulder crutches -- the most space-consuming walking aid.

2. A passage 120 cm wide will allow two people to pass abreast and will allow a wheelchair to turn through a doorway opening into the passage. Table 8 shows other passage dimensions which might be involved.

3. A passage 180 cm wide will allow three normal ambulatory people or two with shoulder crutches to walk abreast. Such a passage is also adequate for any wheelchair maneuver if passage length is at least 180 cm.

The data in Tables 9 and 10 reflect a combination of range of joint movement and arm length. Table 9 shows locations above the floor which can be reached by a grasping hand. The data in Table 10 reflect joint motion range and arm length expressed in terms of a multidimensional volume of space through which the hand moves. The data in both tables show reach access capability but cannot be directly compared across tables. Data in Table 11 illustrate the maximum body flexibility envelope based on possible joint movement only; they do not represent an access envelope.

Subjects measured for Table 9 were chosen to represent the range in body size for U.S. Air Force personnel in 1964 (type of personnel was not specified in the summary in Damon, et al (13)) but can be considered as representative of this population). Population samples of Tables 10 and 11 are apparently not as rigorously standardized. The amputee sample for the data in Table 10 may be quite heterogeneous with respect to the exact location of amputation, even though above and below elbow amputees are identified. Therefore, the data may not be highly valid for an individual amputee although still generally descriptive of the reach volume of amputees as a group.

Tables 12 through 15 present data from a number of different experiments. These data are based on small numbers of subjects performing specified tasks in laboratory settings to test somewhat limited hypotheses. Therefore, these data reflect some of the factors involved in dexterity but do not describe the performance of general populations.

The essential point of the study by Kvalseth (31), Table 12, is that an operator can "feel out" a precision task much more accurately with hand movements than by whole arm movements. For example, setting a range burner control to "high", "medium" or "low" can be done accurately using whole arm movement; setting an oven control to exactly 325 degrees is better achieved by hand-finger manipulation.

Elfant's manipulative task performance study (20), Table is of special interest because the findings do not support the stereotype that blind people possess superior kinesthetic capabilities to the normally sighted. The kinesthetic test results (arm position judgment) were no better for the blind than for the blindfolded-sighted and may have been inferior for the blind.

The data on plegic dexterity in Table 14 show best performance for the paraplegics and the worst for the left arm hemiplegics (average standard score 44). Bell et al (6) conclude that the paraplegics are in need of some retraining for general rehabilitation while the right-arm and left-arm hemiplegics are greatly in need of retraining for such tasks as clothing management. It is further concluded that the hemiplegics have the lowest dexterity capability because of more advanced age, poorer general health, and possibly greater central nervous system involvement than the paraplegics.

The comparison of walking characteristics of elderly versus young women, shown in Table 15, produced no unusual results, but it is clear that the elderly have a shorter step length. The authors make the following observation (Finley et al (21) page 143):

> "The average whole body velocity was 0.26 mile per hour slower for the elderly group (elderly--group average, 1.57 miles per hour; young--group average, 1.83 miles per hour). However, when the data were distributed by half mile per hour class intervals ranging from 0.5 mile per hour through 2.5 miles per hour, none of the young women appear in the 0.5 to 1.0 mile per hour class interval. For the elderly women, the mode occurred in the interval, 1.0 to 1.5 miles per hour (48 per cent of subjects) while 75 percent of the young women were in the 1.5 to 2.0 miles per hour class."

The implication of this finding is that elderly women are more likely than the young to be in the slow-walking group, even though many of them walk as fast as younger women in normal walking situations.

Data for applying whole body force are shown in Table 16 for grip, in Tables 17 and 18 for push-pull action, in Table 19 for a variety of actions, and in Table 20 for lifting. Force exertion data are greatly influenced by measurement technique, motivation, and maximum force criteria. The data from Tables 16 and 17 were obtained by using a variety of procedures and the various populations cannot be equated for motivation, although maximum effort was sought from all subjects. The whole body push-pull data in Table 18 are presented as a function of body position and body bracing. These data, also, are maximum effort data. The data presented in Table 19 are described by the authors (Davis and Stubbs, 14a and 14b) as "safe" levels of force application in terms of "intra-truncal" pressures generated

within the body when applying these types of forces. However, the authors qualify their data as follows (14b, page 219):

> "The diagrams indicate single loads or forces (kg) which can be applied safely by fit young adult males in manual activity when standing, sitting or kneeling. The weakest personnel will be at the limit of safety when applying forces of the magnitudes indicated in the diagrams. If the force has to be applied at frequencies greater than once a minute the safe load will be 70 percent of the values shown. Caution should be exercised in applying these limiting values to men over 35 years of age. They are not applicable to females."

These cautions are further emphasized by the small size of the sample for this study.

In Table 20, the weights lifted in the studies are presented in terms of user acceptance--that is, the maximum weight a person considered reasonable to carry, implying that these weights were less than the maximum which people were capable of lifting. This implication is most explicit in the study by Kramer and Meguire (30) in which the process of judging acceptability was in itself a subject of investigation.

When considering force application data from Tables 16-20:

1. Data from Tables 16-18 should be considered as emergency level force application data and not as everyday force use data for the populations involved.

2. Data from Table 19 can be considered as occasional force use data for the populations involved but should not be used for populations where the weight lifting capability may be less than that of young, fit males.

3. The data from Table 20 may be considered as nominal force application data for the populations involved.

3.0 Household Safety

This section concerns aspects of the home or of the resident that are associated with accidents and household safety. Data tables are presented in five general categories:

Category	Tables
• Personal background of residents involved in accidents	21 through 23
• Use of tobacco, alcohol, and drugs	24 through 29
• Household equipment and facility factors in accidents	30 through 36
• Fires and burns	37 through 39
• Safety recommendations	40 through 42

As a general caveat it must be noted that accident data not collected under highly controlled and thoroughly observed and documented real-world environments may have low validity because many environmental and situational factors are unknown. These conditions for collecting accident data do not prevail in most homes and can rarely be produced in controlled laboratory settings without distorting real-world accident processes. Therefore, data presented in Tables 21 through 36 describe tendencies and scenarios but are not accurate records of events and conditions in the home.

Resident background data presented in Table 21 illustrate some of the cautions noted above. These data were obtained under laboratory conditions designed to record accidents during standardized task performance, but, hazards could not be realistically produced. For example, spilled grease could not be allowed to remain on the floor because a subject might slip on it. Partly as a result of such constraints the correlations, though statistically significant, reveal very low levels of actual covariance.

Inspection of the correlations reveals numerous patterns; for example, the negative visual acuity correlations in combination with the positive manual dexterity correlations. However, recognition of such patterns would be greatly enhanced if multivariate rather than univariate statistics had been used.

Respondents from households with no injuries (control) and with injuries (code) answered questions on a variety of household and personal factors (see Tables 22, 23). Responses about exercise and product quality indicate that respondents from households with injuries tend to have a lower level of exercise, buy reconditioned or blemished products, and assemble and repair products themselves. Where differences between household categories were statistically significant, they were not large.

Data on tobacco use (Table 24) were derived from the same procedures as those used in Tables 22 and 23. Generally, a higher accident tendency exists for cigarette and cigar smokers than for non-smokers; the difference is not significant for pipe smokers.

The data in Table 25 on the association between high breathalyzer alcohol level and home accidnets do not show a higher percentage of intoxication than non-intoxication for any factor considered. The greatest spreads of percentage points were for men versus women (31.5 percent versus 15.3 percent) and social class I and II versus social class V (13.4 percent versus 26.1 percent). Tohuhata's data in Table 26 show no statistically significant tendency toward association of household injuries and alcohol use other than for beer. However, these data did not consider level of drinking. The highest percentages for cause of injuries and type of injuries for intoxicated accident victims (Table 27) are cutting and piercing and collisions, and lacerations/abrasions and head injuries. In general, victims cut themselves and collide with objects. Head injuries probably result from both falls and collisions.

Data in Table 28 highlight drug availability as an accident factor. The availability of antihistamines, tranquilizers, diet pills and hormones, but not the antidepressants, was most frequently reported for homes with injuries. However, it is unknown how much of this effect can be related to drug action and how much to the conditions requiring drug use.

Table 29 presents data on several aspects of medication error by the elderly. The significant medication management factors seem to be related to the medication process and not to the design of the house itself.

Tables 30 through 36 show data from various surveys of home factors in accidents, especially falls. Unfortunately, data provided by respondents about what actually happened in a home accident are often unreliable. For that reason, these tables should be used only to develop accident scenarios. Generally, self-reported accidents tended to occur in the living room, kitchen, or on the stairs, and on slippery, non-concrete surfaces. As an accident factor, elderly victims tended to report dizziness, sudden malaise or weakness, and difficulty in walking.

The fire mortality pattern shown in Table 37 is familiar--high death rates among the very young, the very old, and non-whites.

Regarding specific hazards, Table 38 indicates that clothing is the most common source of fatal burns and that hot water is the most common source of non-fatal burns. Frequent pre-existent factors in burn cases are cardiovascular disease and alcohol use for male victims and cardiovascular disease and obesity for female victims (see Table 39).

Tables 40-42 are recommendations for household safety design. They are not a complete design guide but do contain or are based upon recent and authoritative data and standards.

4.0 Disability

The disability data are contained in the following tables:

Category	Tables
• Disability background	43 and 44
• Hearing	45 and 46
• Disability description	47

Table 43 presents some background information on distribution of disabilities in the U.S. population.

Information in Table 44 is purely qualitative. Its value lies in conceptualizing types of risk which might be typical of disabled individuals. It should be noted that the disabilities listed are primarily motor; but as the figure indicates, they have implications for other than motor problems.

Hearing condition data shown in Tables 45 and 46 apply only to children. However, it should be noted that deaf children have many of the same problems in a home as do deaf adults. Also, the children of 1963-65 are the adults of today; thus, the data may be predictive of current problems for deaf adults.

Table 47 lists organizations serving various disabled groups. These organizations can provide much information about the disability they represent. Full address information is listed in Appendix A for readers who wish to contact the organizations directly.

5.0 Household Operations

The data on household operations are presented in the following tables:

Category	Tables
• Household time use	48 through 53
• Household equipment use	54 through 56
• Task difficulty	57 through 60

Summarized data on household time use are taken primarily from Robinson (49). While other time use sources are available, e.g. Manning (37) and Walker and Woods (75), Robinson's data are in the most useful format. They reflect primarily urban people, based on diaries from a large sample of 2000 respondents. Robinson's data are generally compatible with data from Walker and Woods and Manning.

The use of time diaries for a single day results in some distortion of time when certain occasional or family specific time data are averaged over many days and applied to the whole population or some large segment of it. For example, unrealistically short daily time segments for child care may result. There are also some minor arithmetic inconsistencies in Robinson's data which are probably due to data processing techniques. These data should be interpreted as general tendencies rather than as specific time values.

A rank order of the major household weekly time totals from Table 48, in order of magnitude for each type of householder, is as follows:

Employed Men	Employed Women	Housewives
Marketing	Cooking	Cooking
House upkeep	Housecleaning	Housecleaning
Cooking	Laundry/ironing	Laundry/ironing

Table 49 presents the results of a multivariate analysis of factors associated with housework time for men and women. This analysis emphasizes the limitations of average task time data as a basis for housework time analysis--for example, the disproportionate size of the standard deviations with respect to the size of the means.

Table 50 presents data on the time requirement for and frequency of preparation of meals of various complexity.

Table 51 indicates that housewives spend the most time on child care, employed men the least. These tendencies probably reflect the use of out-of-home child care or in-home babysitting, as well as the lower number of children of employed men and women.

The personal time shown in Table 52 is personal maintenance time. The greatest consumption of time (except for sleeping) is for personal hygiene and snacking. Most of the eating by employed men and employed women is done outside of the home, and this probably includes snacking, if the cooking data in Table 48 are any indication of all in-home cooking.

Table 53 indicates that the most extensive use of free time in the home involves watching TV, although it is not clear if this is TV watching time or total time the TV is turned on. In any event, the heavy time emphasis on TV suggests that Robinson's 1956 data are indicative of present day household time use.

The data presented in Tables 54 through 56 on household equipment use are from Walker and Woods. Since these data are now at least ten years old and pre-"energy crisis" they may not reflect current practice. For example, current use of air conditioning may be more extensive than shown in Table 54.

Table 55 indicates a typical assortment of kitchen equipment, although the reported percentage of use of electric fry pans, griddle and fryers might be somewhat low for present-day practice. There is no mention of microwave ovens.

The task difficulty data in Tables 57 through 60 are taken from Steidl (60). Her analysis categorizes various household activities as high or low cognitive tasks. High and low cognitive tasks are those which were judged to require high and low amounts of attention, judgment and planning. It is important to note that high and low cognition is not so much a dichotomy of difficulty as it is a two-part heading for tabulating respondents' judgments into a matrix distribution. In principle, the cognitive level of a task is probably as relevant to the evaluation of task performance by the disabled as it is to task performance by others. However, specific tasks may be judged differently by the disabled than by normals and differently by some disabled than by others.

As seen in Table 57, food preparation tasks are relatively high in both frequency of listing and cognitive level. Shelter tasks are high in frequency and low in cognitive level as are clothing care tasks, except sewing. However, Table 58 indicates a general "constraint" factor which cuts across cognition level in making tasks more or less difficult.

Table 59 indicates that the most critical domiciliary factors in housework difficulty are structure, and facilities and equipment design and layout.

Table 60, however, does indicate that high vs low cognition is still a factor is determining the complexity and difficulty of tasks, as well as task preferences.

6.0 Summary and Conclusions

The data in this report, due to their range, complexity and diversity of application, lead to general conclusions:

1. The quality of anthropometric and biomechanical data are affected by the collecting procedures and equipments utilized. However, these data can be used as prescriptive, "design-to" data guides according to the nature of the population sampled and with caution as to the size and probable representativeness of each sample.

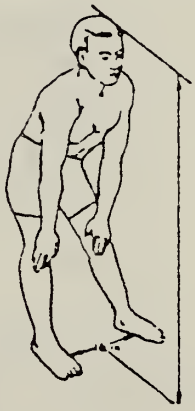
2. The household safety data are valid as a description of specific populations at specific time periods. However, much of the data were obtained in laboratory situations or were otherwise limited by the study.

3. The disability data are descriptive samples of disabilities which may be encountered within an otherwise normal home. They are useful primarily for familiarization with the general handicaps of the disabled.

4. The household operations data are useful for formulating scenarios. They may suggest design considerations but should not be utilized as standards.

ILLUSTRATED GLOSSARY OF SELECTED ANTHROPOMETTIC AND BIOMECHANICAL MEASUREMENTS

Illustrated Glossary of Selected Anthropometric and Biomechanical Measurements

Measurement	Table	Illustration
Ankle Abduction and Adduction	11	(13)*
Ankle Flexion and Extension	11	(13)*
Bent Torso Breadth	3	(69)
Bent Torso Height	3	 (69)

*Courtesy: Harvard University Press

Crawling Length 3

Crawling Height 3

(69)

Elbow Flexion 11

(13)*

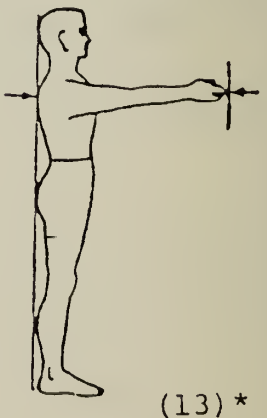
Elbow Rest Height 1

(8)

Forearm Supination and Pronation 11

(13)*

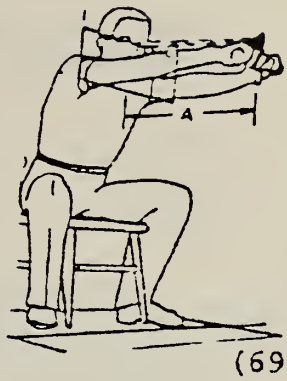
Forward (Finger Tip) Arm Reach 2



(13)*

*Courtesy: Harvard University Press

Forward Reach, Sitting (Through Aparture) 2

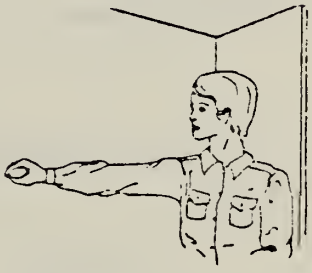


(69)

Function (Grip) Arm Reach 2

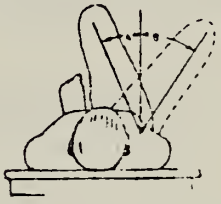
(69)

Functional (Grip) Arm Reach, Extended 2



(1)

Hip, Adduction and Abduction 11

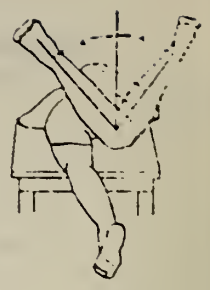


(13)*

Hip Flexion 11

Courtesy: Harvard University Press (13)

Hip Rotation, Medial and Lateral, Prone 11



(13)*

Hip Rotation, Medial and Lateral, Seated 11

(13)*

Knee Flexion, Kneeling 11

(13

Knee Flexion, Prone 11

(13)*

Knee Flexion, Standing 11

(13)*

*Courtesy: Harvard University Press

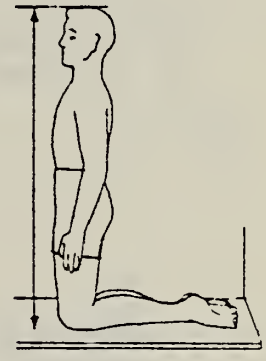
Knee Rotation, Medial and Lateral — 11

(13)*

Crouched and Length, Kneeling Height — 3

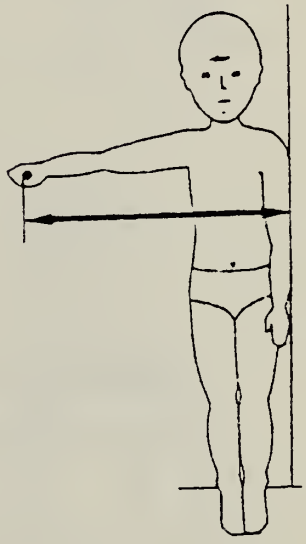
(69)

Kneeling Height, upright — 3



(69)

Lateral Grip Reach — 2



(55)

*Courtesy: Harvard University Press

Neck Flexion, Dorsal and Ventral — 11

(13)*

Neck Flexion, Right and Left — 11

(13)*

Neck Rotation, Right and Left — 11

(13)*

Overhead Reach, Standing Two Arms, Grip — 2

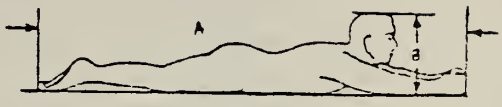
(1)

Popliteal Height — 1

(13)*

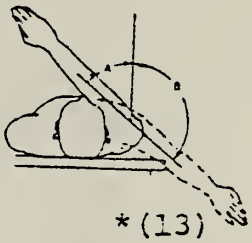
*Courtesy: Harvard University Press

Prone Length and Height — 3



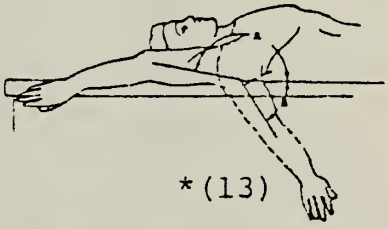
(69)

Shoulder Adduction and Abduction — 11



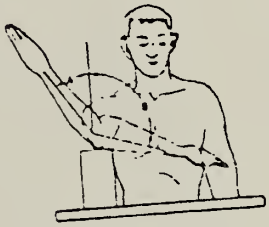
*(13)

Shoulder Flexion Extension — 11



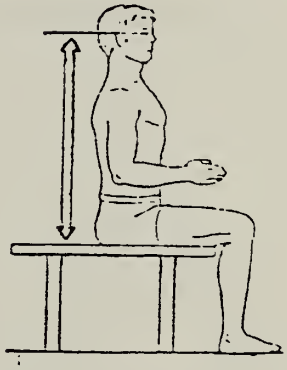
*(13)

Shoulder Rotation, Lateral and Medial — 11



(13)*

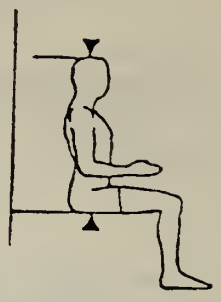
Sitting Eye Height — 1



(80)

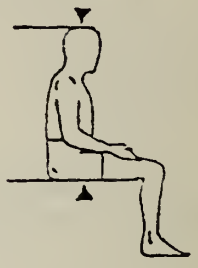
*Courtesy: Harvard University Press

Sitting Height, Erect 1



(8)

Sitting Height, Normal 1

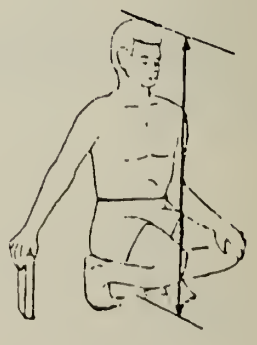


(8)

Sitting Knee Height 1

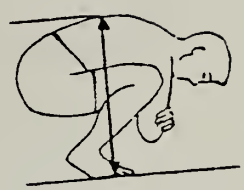
(8)

Squatting Height 3



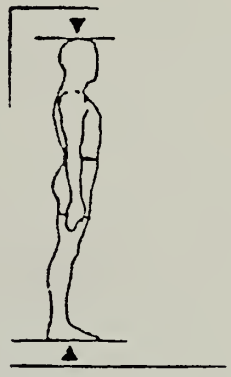
(69)

Squatting Height, Minimum 3



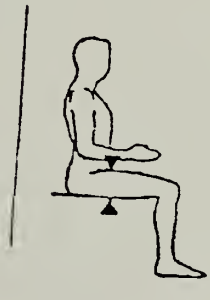
(69)

Stature (Standing Height) 1



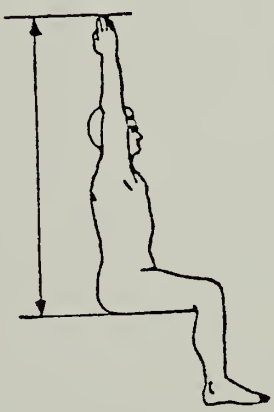
(8)

Thigh Clearance Height 1



(8)

Vertical Reach, Finger Tip,
Sitting 2

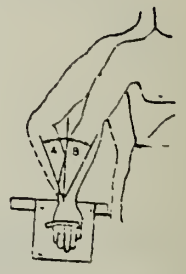


(69)

Vertical Reach, Grip
Standing 2

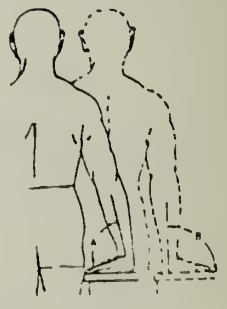
(69)

Wrist Abduction and
Adduction 11



(13)*

Wrist Flexion and
Extension 11



(13)*

*Courtesy: Harvard University Press

TABLES

ANTHROPOMETRY AND BIOMECHANICS

TABLE I ANTHROPOMETRIC DATA SUMMARY - HEIGHT

Dimension (See Glossary)		Adult Male (80)	Adult Male 35-44 Yr. (77)	Adult Female (1)	Adult Female (53)	Adult Female 35-44 Yr. (77)	Old Male 75-79 Yr. (77)	Old Female 75-79 Yr. (77)	14-15 Yr. Male (55)	14-15 Yr. Female (55)	11 Yr. Male Negro (01	11 Yr. Male White (8)	10-11 Yr. Male (55)	11 Yr. Female Negro (8)	11 Yr. Female White (8)	10-11 Yr. Female (55)	6 Yr. Male Negro (8)	6 Yr. Male White (8)	5-6 Yr. Male (55)	6 Yr. Female Negro (8)	6 Yr. Female White (8)	5-6 Yr. Female (8)
Stature (Standing Height) (cm)	(N)	(6682)	(7031	(1331)	(422)	(784)	(72)	(70)	(131)	(133)	(83)	(542)	(142)	(84)	(477)	(140)	(841	(489)	(117)	(72)	(471)	(1251
	* 1st	158.87	158.24	148.17	157.10	146.30	146.56	118.87	146.0	143.2	--	--	130.7	--	--	133.3	--	--	102.9	--	--	96.5
	5th	163.79	163.07	149.90	157.62	151.30	155.70	140.46	149.7	152.3	134.5	134.6	133.8	136.2	135.1	137.3	111.3	110.4	106.1	106.5	108.3	104.9
	%tile 50th	174.41	172.97	162.75	166.07	161.04	160.15	156.97	167.0	161.3	146.0	145.8	142.1	148.4	147.3	149.3	118.6	118.4	114.6	118.8	117.6	114.3
	95th	185.57	184.15	176.78	174.77	170.69	179.07	164.85	179.6	172.4	159.2	156.9	151.5	161.7	159.4	159.9	129.5	127.8	124.7	127.5	126.4	121.7
	*99th	190.26	188.21	178.41	177.93	175.26	184.40	173.23	186.0	181.6	--	--	160.2	--	--	169.0	--	--	128.4	--	--	128.7
Sitting Height, Erect (cm)	(N)	(6682)	(703)	(1331)	(419)	(784)	(72)	(70)	(131)	(131)	(83)	(452)	(139)	(84)	(477)	(139)	(84)	(489)	(116)	(72)	(461)	(1251
	* 1st	81.96	81.79	76.27	80.82	76.96	70.36	45.21	72.2	75.5	--	--	68.5	--	--	65.2	--	--	56.0	--	--	53.2
	5th	85.54	85.60	79.01	82.38	80.01	80.77	71.37	76.9	79.4	67.8	70.6	69.3	68.3	70.4	69.3	59.2	60.4	58.4	57.4	59.2	57.9
	%tile 50th	90.75	91.44	85.17	87.13	83.60	87.12	81.33	85.2	84.6	73.6	75.5	73.8	75.3	76.2	74.8	63.2	65.1	63.4	62.3	64.3	63.2
	95th	96.98	96.52	90.82	93.07	90.43	88.22	88.39	93.4	90.0	79.3	80.7	79.0	81.4	83.7	81.1	68.1	69.2	68.2	66.6	69.1	67.4
	*99th	99.18	98.81	92.74	94.09	93.47	95.50	90.68	98.9	93.7	--	--	83.0	--	--	84.6	--	--	70.7	--	--	91.7
Sitting Height, Normal (cm)	(N)		(703)			(784)	(72)	(70)														
	* 1st		78.63			74.17	67.82	37.59														
	5th		81.28			76.70	75.69	68.83														
	%tile 50th		87.12			82.80	84.58	70.74														
	95th		93.22			88.65	90.93	84.84														
	*99th		95.76			90.93	93.22	88.90														
Sitting Eye Height (cm)	(N)	(6602)		(1331)	(423)				(42)	(39)			(41)			(44)			(381			(41)
	* 1st	90.10		65.20	69.47				62.8	66.3			54.6			57.1			46.5			43.2
	5th	72.78		67.71	71.47				66.0	67.7			55.6			57.7			46.6			45.2
	%tile 50th	78.76		73.79	76.04				72.9	74.4			61.1			63.2			52.1			52.2
	95th	84.62		79.18	80.58				80.6	77.9			64.9			69.9			56.4			56.8
	*99th	83.04		81.63	82.44				83.4	79.0			66.0			73.2			56.8			60.2
Sitting Knee Height (cm)	(N)	(6682)	(703)	(1331)	(423)	(784)	(72)	(701	(127)	(1321												
	* 1st	47.66	46.74	45.50	46.81	43.69	45.72	41.40	46.4	43.6												
	5th	49.72	49.28	46.90	48.41	45.72	40.26	43.94	47.6	45.9												
	50th	53.99	54.61	50.09	51.95	49.78	52.08	49.28	52.9	49.6												
	95th	58.72	54.99	36.60	55.59	54.61	57.66	53.09	58.3	55.0												
	*99th	60.63	61.98	57.14	56.80	56.90	59.18	54.61	60.26	57.3												

TABLE I ANTHROPOMETRIC DATA SUMMARY - HEIGHT (CONTINUED)

Dimension (See Glossary)		Adult Male (80)	Adult Male 35-44 Yr. (77)	Adult Female (1)	Adult Female (53)	Adult Female 35-44 Yr. (77)	Old Male 75-79 Yr. (77)	Old Female 75-79 Yr. (77)	14-15 Yr. Male (55)	14-15 Yr. Female (55)	11 Yr. Male Negro (8)	11 Yr. Male White (8)	10-11 Yr. Male (55)	11 Yr. Female Negro (8)	11 Yr. Female White (8)	10-11 Yr. Female (55)	6 Yr. Male Negro (8)	6 Yr. Male White (8)	5-6 Yr. Male (55)	6 Yr. Female Negro (8)	6 Yr. Female White (8)	5-6 Yr. Female (8)
Sitting Knee Height (cm)	(N)	(6682)	(703)	(1331)	(423)	(784)	(72)	(70)	(127)	(132)			(140)			(139)			(107)			(107)
	1st	47.66	46.74	45.50	46.81	43.69	45.72	41.40	46.4	43.6			40.1			17.9			10.3			29.6
	5th	49.72	49.28	46.90	48.41	45.72	48.26	41.94	47.6	45.9			41.0			41.2			11.4			31.6
%tile	50th	53.99	54.61	50.89	51.95	49.78	52.88	49.28	52.9	49.6			45.4			45.5			35.2			34.4
	95th	58.72	54.99	56.60	55.59	54.61	57.66	51.09	58.1	55.0			48.9			50.6			38.9			17.7
	*99th	60.63	61.98	57.14	56.89	56.90	59.18	54.61	60.26	57.3			51.7			53.3			40.6			39.2
Popliteal Height (cm)	(N)	(6682)	(703)	(1311)	(422)	(784)	(72)	(70)			(83)	(452)		(84)	(477)		(84)	(489)		(72)	(461)	
	1st	38.35	38.10	36.39	39.15	33.23	38.10	24.38			--	--		--	--		--	--		--	--	
%tile	5th	40.59	39.62	37.97	40.35	35.36	38.61	34.29			35.1	33.5		34.2	31.2		27.1	26.3		26.4	25.8	
	50th	44.53	41.99	41.54	43.42	39.88	42.16	39.62			38.5	37.2		38.4	37.4		30.1	29.2		29.7	28.8	
	95th	48.82	48.51	45.74	47.02	44.45	46.74	43.69			42.2	41.0		43.9	41.0		33.8	32.1		33.4	31.7	
	*99th	50.45	50.55	47.30	48.22	45.47	49.02	61.21			--	--		--	--		--	--		--	--	
Thigh Clearance Height (cm)	(N)		(703)	(2551		(784)	(72)	(70)	(42)	(39)			(41)			(44)			(37)			(41)
	1st		10.41	--		10.16	9.91	8.11	10.0	10.6			10.0			9.2			7.5			7.6
%tile	5th		11.68	13.22		10.67	10.41	10.16	11.1	11.1			10.1			10.0			7.8			7.7
	50th		14.73	15.44		13.87	13.21	13.21	13.8	14.1			11.5			12.1			9.2			9.5
	95th		17.78	17.51		17.78	16.76	16.51	17.0	16.6			13.3			14.1			10.8			11.4
	*99th		19.81	--		19.81	18.29	17.53	17.7	17.0			13.7			**			11.0			12.4
Elbow Rest Height (cm)	(N)		(703)	(255)	(423)	(784)	(72)	(70)														
	1st		16.51	--	17.60	17.02	14.48	7.11														
%tile	5th		19.80	16.12	19.62	19.05	16.51	16.26														
	50th		24.64	20.84	24.29	23.18	21.81	21.34														
	95th		29.97	25.04	27.84	28.70	26.92	25.40														
	*99th		12.00	--	29.26	30.48	27.94	27.18														

(1) U.S. Army, Natick, 1977, U.S. Army female
(8) National Health Survey, 1963-65, General Population U.S.
(53) Snow, et al, 1975, Airline Stewardesses
(55) Snyder, et al, 1977, U.S. Infants and Children
(77) National Health Survey, 1960-62, Elderly, Adult General Population.
(80) White, 1966, U.S. Army male

*Snyder (55) "minimum" and "maximum"
**17.60 cm is probably not an acceptable value as a 99th %tile equivalent

TABLE 2 ANTHROPOMETRIC DATA SUMMARY - REACH

Dimension (See Glossary)		Adult Male (80)	Adult Male (69a)	Adult Male (69b)	Adult Male (69c)	Adult Male (69e)	Adult Male (69g)	Adult Male (69h)	Adult Male (69i)	Adult Male (69j)	Adult Female (1)	Adult Female (53)	Male 17-19 Yrs. (55)	Female 17-19 Yrs. (55)	Male 12-13 Yrs. (55)	Female 12-13 Yrs. (55)	Male 6-7 Yrs. (55)	Female 6-7 Yrs. (55)
Forward	(N)			(NA)			(NA)		(NA)	(NA)		(422)						
(Fingertip)	1st			78.49			81.03		80.26	82.04		72.03						
Arm Reach	5th			81.03			83.37		83.06	85.09		73.79						
(cm)	tile 50th			87.88			90.68		90.68	91.94		78.65						
	95th			94.74			97.54		97.03	97.79		84.61						
	99th			98.04			100.33		100.33	100.58		86.99						
Functional	(N)	(6682)	(NA)	(NA)		(NA)**					(302)		(22)	(22)	(30)	(47)	(33)	(41)
(Grip)	*1st	71.89	72.64	73.15		-					-		63.6	62.8	56.3	56.9	46 9	43.2
Arm Reach	5th	74.90	74.42	78.44		51.43					64.02		64.3	62.8	57.8	57.3	47.1	44.7
(cm)	tile 50th	82.45	79.76	82.04		60.32					71.00		73.6	66.5	64.4	64.0	51.2	50.0
	95th	90.92	86.36	86.90		67.94					78.99		81.2	73.4	72.0	72.8	57.5	55.1
	*99th	94.62	89.15	92.46		-					-		82.1	75.2	78.1	74.2	61.9	56.0
Functional	(N)										(300)							
(Grip)	1st										-							
Arm Reach	5th										73.47							
Extended	tile 50th										83.20							
(cm)	95th										92.67							
	99th										-							
Vertical	(N)				(NA)								(22)	(22)	(30)	(48)	(33)	(38)
(Grip)	1st				-								205.8	188.4	166.0	170.2	127.5	128.3
Reach	*5th				195.07								206.0	188.4	174.7	172.7	128.1	130.2
Standing	tile 50th				209.55								213.0	196.4	188.5	188.7	144.2	143.7
(cm)	95th				224.79								228.9	205.6	208.5	208.0	158.0	159.0
	*99th				-								232.2	218.6	220.0	217.5	163.5	164.2
Overhead	(N)										(300)							
Reach	1st										-							
Standing	5th										185.29							
Two Arms	tile 50th										198.56							
(Grip)	95th										215.06							
(cm)	99th										-							

TABLE 2. ANTHROPOMETRIC DATA SUMMARY REACH (CONTINUED)

Dimension (See Glossary)		Adult Male (80)	Adult Male (69a)	Adult Male (69b)	Adult Male (69c)	Adult Male (69e)	Adult Male (69q)	Adult Male (69h)	Adult Male (69i)	Adult Male (69j)	Adult Female (1)	Adult Female (51)	Male 17-19 Yrs. (55)	Female 17-19 Yrs. (55)	Male 12-13 Yrs. (55)	Female 12-11 Yrs. (55)	Male 6-7 Yrs. (55)	Female 6-7 Yrs. (55)
Vertical	(N)	(6682)						(NA)			(300)	(423)						
(Fingertip)	1st	124.68						-			-	121.83						
Reach	5th	128.74						131.06			117.38	124.62						
Sitting	tile 50th	138.25						139.70			129.32	133.62						
(cm)	95th	147.77						149.65			139.44	140.12						
	99th	152.61						-			-	143.92						
Lateral	(N)												(22)	(21)	(50)	(47)	(33)	(40)
Grip	1st												96.8	82.7	78.2	75.3	58.4	60.1
Reach	5th												97.1	82.8	79.2	78.2	59.9	60.3
(cm)	tile 50th												105.8	90.6	86.3	85.7	67.7	66.1
	95th												122.2	96.7	97.1	94.7	74.2	73.2
	99th												124.3	98.0	102.8	98.9	74.8	75.5
Forward Reach	(N)																	
Sitting	1st					-												
(Through 40.94 cm	5th					38.10												
chest	tile 50th					45.08												
aperture	95th					56.51												
(cm)	99th					-												

(1) US Army, Natick, 1977, US Army, Women
(53) Snow, et al, 1977, Airline Stewardesses
(55) Snyder, et al, 1977, U.S. infants and children
(69) Van Cott and Kinkade, from:
a. Gifford, et al, 1965, Naval Aviation, Male
b. Hertsberg, et al, 1954, USAF, Male
c. Hertzberg, et al, 1956, USAF, Male
e. Kennedy and Filler, 1966, USAF, Male
g. McFarland, et al, 1950, truck and bus driver
h. Snow and Snyder, 1965, Air Traffic Control Trainees
i. USN, 1955, Enlisted Men
j. White, 1966, US Army, Male

(80) White and Churchill, 1960, US Army, Male

*Snyder(11) "minimum" and "maximum"
**Horizontal neck from shoulder through 30.48 cm aperture (functional grip arm reach) and 25.40 cm aperture (lateral grip reach)

TABLE 3. ANTHROPOMETRIC DATA SUMMARY - WHOLE BODY POSITION

Dimension (see Glossary)			Adult Male (69a)	Adult Male (69b)	Adult Male (69c)	Adult Female (1)
Bent Torso Height (cm)	% tile	(N)	(NA)			(300)
		1st	-			-
		5th	117.60			112.73
		50th	132.08			126.28
		95th	141.99			138.61
		99th	-			-
Bent Torso Breadth (cm)	% tile	(N)	(NA)			(300)
		1st	-			-
		5th	41.40			36.77
		50th	44.45			46.10
		95th	48.51			43.48
		99th	-			-
Kneeling Height, Upright (cm)	% tile	(N)	(NA)			(300)
		1st	-			-
		5th	122.43			114.47
		50th	129.54			122.92
		95th	138.18			130.26
		99th	-			-
Kneeling Height, Crouched (cm)	% tile	(N)		(NA)		
		1st		-		
		5th		75.44		
		50th		81.28		
		95th		87.63		
		99th		-		
Squatting Height (cm)	% tile	(N)	(NA)			
		1st	-			
		5th	103.63			
		50th	110.74			
		95th	119.38			
		99th	-			
Minimum Squatting Height (cm)	% tile	(N)			(NA)	
		1st			-	
		5th			54.61	
		50th			62.99	
		95th			71.12	
		99th			-	
Crawling Height (cm)	% tile	(N)		(NA)		
		1st		-		
		5th		66.55		
		50th		72.14		
		95th		77.47		
		99th		-		

TABLE 3. ANTHROPOMETRIC DATA SUMMARY - WHOLE BODY POSITION (CONTINUED)

Dimension (See Glossary)		Adult Male (69a)	Adult Male (69b)	Adult Male (69c)	Adult Female (1)
Prone Height (cm)	(N)		(NA)		
	1st		-		
	% 5th		31.24		
	tile 50th		36.83		
	95th		41.66		
	99th		-		
Kneeling Length (cm)	(N)		(NA)		
	1st		-		
	% 5th		95.50		
	tile 50th		109.22		
	95th		123.27		
	99th		-		
Crawling Length (cm)	(N)		(NA)		
	1st		-		
	% 5th		123.22		
	tile 50th		135.13		
	95th		147.83		
	99th		-		
Prone Length (cm)	(N)			(NA)	
	1st			-	
	% 5th			215.14	
	tile 50th			228.85	
	95th			243.33	
	99th			-	

(1) U.S. Army Natick, 1977, U.S. Army, Women
(69a) Van Cott and Kinkade, from Alexander and Clauser, 1965, USAF, Male
(69b) Van Cott and Kinkade, from Hertzberg et al, 1956, USAF, Male
(69c) Van Cott and Kinkade, from Snow and Snyder, 1965, Air traffic control trainees, Male

TABLE 4 ANTHROPOMETRIC DATA SUMMARY - WHEELCHAIR AND OCCUPANT

Dimension*	Occupant/Chair Dimensions (cm)												Remarks
	Male Adult (22) N = 60			Female Adult (23a) N = 36			Male Child (23b) N = NA			Female Child (23b) N = NA			
	5th %tile	Mean	95th %tile	5th %tile	Mean	95th %tile	5th %tile	Mean	95th %tile	5th %tile	Mean	95th %tile	
Vertical reach (A)	160.5	171.5	-	146.5	147.5	-							Data deficiencies are emphasized by Goldman (23), pp. 118-119 (adults) and p. 124 (children).
Oblique vertical reach (B)	150.0	159.5	-	137.5	146.5	-							
Forward vertical reach (C)	132.5	141.0	-	121.0	129.0	-							
Head height (D)	123.5	133.5	142.5	115.5	125.5	135.5	-	120.0	-	-	119.0	-	
Eye level (E)	113.5	122.5	132.0	106.0	115.5	125.0	-	110.0	-	-	90.0	-	
Shoulder level (F)	95.0	104.0	113.0	90.0	99.0	108.0							
Chair armrest level (G)	NO DATA			NO DATA									
Elbow level (H)	63.5	69.0	74.5	63.5	69.0	74.5							
Thigh level (J)	-	60.5	66.0	-	60.5	65.5	-	56.5	-	-	56.0	-	
Chair seat level (K)	-	47.5	-	-	47.5	-	-	46.0	-	-	46.0	-	
Knuckle height (L)	-	39.0	40.5	-	42.0	44.0							
Maximum downward reach (M)	-	11.0	24.5	-	12.0	26.0							
Foot height (N)	-	14.5	20.5	-	16.5	21.0	-	20.0	-				
Effective forward reach (O)	51.5	60.0	-	49.5	55.0	-	-	48.0	-	-	27.5	-	
Forward reach beyond face of chair arm (P)	40.0	59.5	-	25.5	41.0	-				-	47.5	-	
Knee projection beyond face of chair arm (Q)	NO DATA			NO DATA									
Toe projection from front of waist (R)	-	59.5 (sitting erect)	64.5	-	53.5 (sitting erect)	57.5							
	-	67.5 (sitting back)	72.0	-	61.0 (sitting back)	65.0							
Toe projection beyond face of chair arm (S)	-	42.0	46.0	-	37.0	41.0							
Toe projection at lower leg level (T)	-	18.5	21.5	-	14.0	17.0							

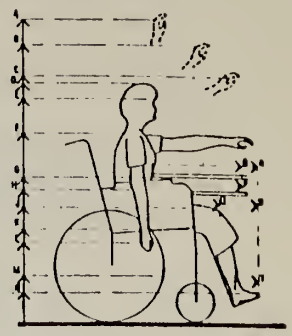


Figure 1: Key to Measurements

Children's data are derived from children in chairs and are not available for most of the dimensions shown in Figure 1: Key to Measurements, this table.

Since the measurement of knuckle height is distance above the floor the 95th %tile value is a 5th %tile downward reach capability.

(23a) Goldsmith, bibliography 93500, 93502, adult paraplegics
(23b) Goldsmith, bibliography 93760, Dreyfuss

*Key may not precisely correspond to all measurement data from Goldsmith (23), Diagrams 20.7-20.12

Data and figure reprinted from Designing for the Disabled by Selwyn Goldsmith with the kind permission of RIBA Publications Ltd.

Table 5. ANTHROPOMETRIC DATA SUMMARY--NORMAL, ROUTINE PASSAGE REQUIREMENTS.

Measurement	Dimensions (cm)		Remarks
	Minimum	Nominal	
Passing space, one passing, one standing against wall (Figure 1)	76.20	91.44	
Passing space, two persons (Figure 2)	111.76	137.16	
Transit space, three persons abreast (Figure 3)	152.40	182.88	

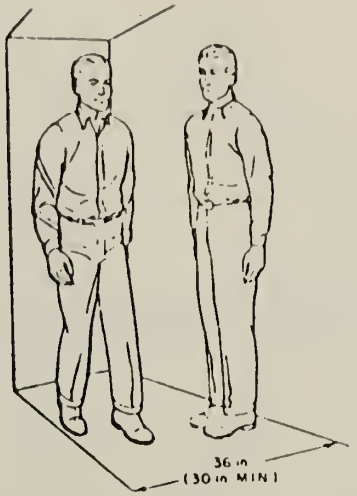


Figure 1

Figure 2

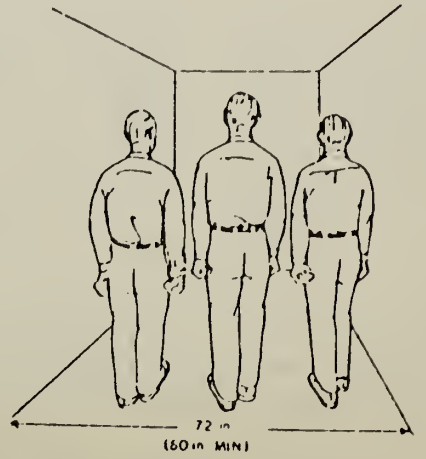


Figure 3

Reference
(69) Van Cott and Kirkade, nominal male adult, not otherwise specified

MEASUREMENT	Dimensions (cm) Occupied	Minimum	Nominal	Desirable
One stick utilization (Figure 1.a)	60.0	-	75.0	-
Two stick utilization (Figure 1.b)	65.0	-	80.0	-
Elbow crutches utilization (Figure 1.c)	78.0	-	90.0	100.0
Shoulder crutches utilization (Figure 1.d)	82.0	90.0	95.0	100.0
Triped walking aid utilization (Figure 1.e)	74.0	-	90.0	100.0
Walking aide, ferrule tips utilization (Figures 1.f and 2.a)	65.0	-	80.0	100.00
Wheeled walking aid utilization (Figures 1.g and 2.b)	66.0	-	85.0	100.0

REMARKS

Following Goldsmith (23), pp.153-154:
Occupied: The space occupied by the static subject and walking aid.
Minimum: The least space utilizable for circulation.
Nominal: The statisfactory utilizable space for circulation.
Desirable: The most preferable utilizable space for circulation, although not a design requirements.

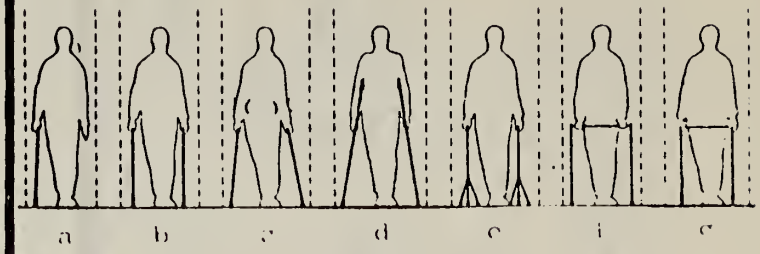


Figure 1

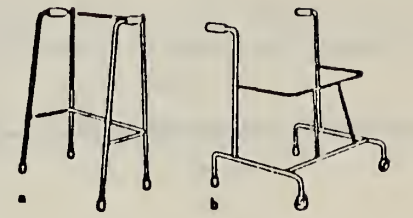
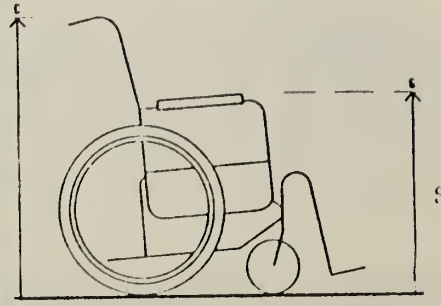


Figure 2

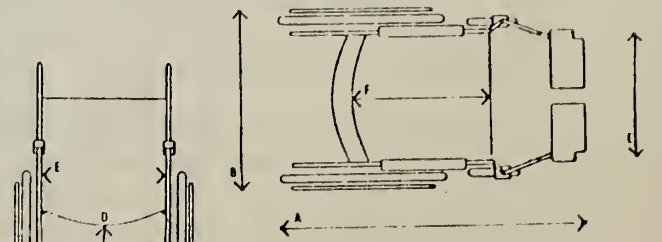
Reference: (23) Goldsmith, "Large man," not otherwise specified
Data and figures reprinted from Designing for the Disabled by Selwyn Goldsmith with the kind permission of RIBA Publications Ltd.

TABLE 7. ANTHROPOMETRIC DATA SUMMARY--WHEELCHAIR DIMENSIONS.

MEASUREMENT	Dimensions (cm) Adult*	Child**	REMARKS
Overall length (A)	106.0	84.0	* Everest and Jennings adult style wheel chair with pneumatic tires.
Overall width (B)	60.5	50.0	
Overall height (C)	92.0	89.5	** UK Department of Health and Social Security, DHSS Model 8C; Children's wheel chair.
Height ground to seat (D)	48.0	46.0	
Seat width between frames (E)	40.0	30.5	
Seat depth (F)	44.0	37.5	
Height ground to arm rest (G)	75.5	62.0	



Side View



Top View

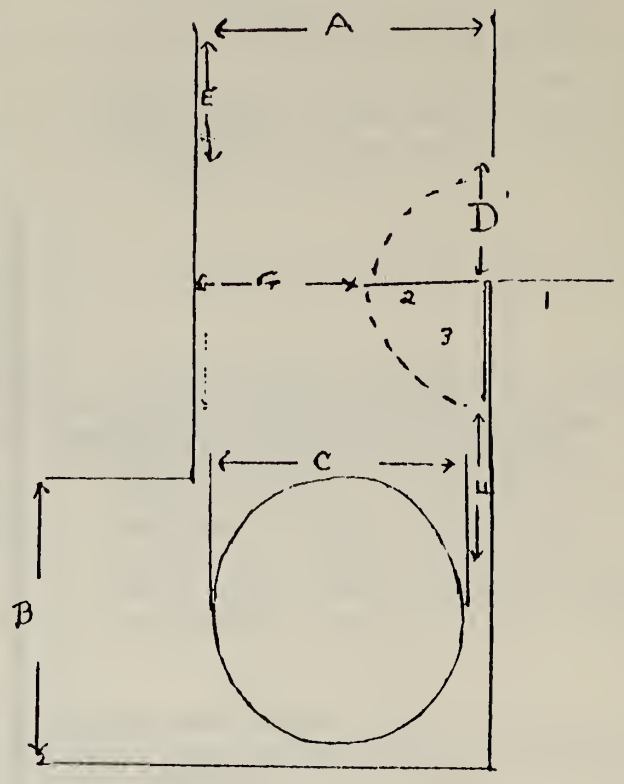
Front View

Figure 1: Measurement & Item Key

Reference (23): Goldsmith, 1976
Data and figures reprinted from Designing for the Disabled by Selwyn Goldsmith with the kind permission of RIBA Publications Ltd.

MANEUVER	MEASUREMENTS	
	Applicable Dimensions	Space Required (cm)
Straight line movement, one chair, no protrusion from wall	A	90.0
Straight line movement, one chair, wall protrusion clearance addition	G	90.0
Passing, two chairs	A	180.0
90° in-place turn	A x E	140.0 x 140.0
180° in-place turn	A x E	140.0 x 180.0
360° in-place continuous turn	C	150.0

REMARKS



1. Door opens out
2. Door opens in, 90° max.
3. Door opens in, 180°

Figure 1. Dimension Key
(not drawn to scale)

TABLE 8. ANTHROPOMETRY, APPLIED, DATA SUMMARY--WHEELCHAIR MANEUVERING SPACE REQUIREMENTS.

MANUEVER	MEASUREMENTS		REMARKS
	Applicable Dimensions	Space Required (cm)	
90° turn in circulation route (e.g. L-shaped hall)	A x B	90.0 x 90.0	D presupposes a 90.0 cm door set with a door leaf 82.6 cm wide and a through door passage space of 77.5 cm.
Minimum space turn through door, with door open out of passage (Door 1, Figure 1)	A x D	90.0 x 77.5	
Preferred space turn through door with door open out of passage (Door 1, Figure 1)	A x D	120.0 x 77.5	
Turn through door with door open into passage (Door 2 or 3, Figure 1) and approaching the door latch side	A x D x E	120.0 x 77.5 x 120.0	Dimension E or F locates the chair outside the door swing path.
Turn through door with door open into passage (Door 3, Figure 1) and approaching door from hinge side	A x D x F	120.0 x 77.5 x 100.0	

Reference (23): Goldsmith, Adult, "Standard," Self-Propelled Wheelchair
Reprinted from Designing for the Disabled by Selwyn Goldsmith with the kind permission of RIBA Publications Ltd.

Reach Configuration	Reach (cm) %tile				Reference and N	Remarks
	Minimum	5th	50th	95th		
Horizontal					(13)	
Left 60°	45.08	46.35	54.61	62.86	20, male	An approximately horizontal right arm thumbtip reach (63.5 cm above seat reference point) at specified angles to the subjects' right or left in a plane at right angle to the seated subjects' seat reference vertical.
Right 15°	69.21	71.75	76.85	85.09		
Right 90°	80.64	81.91	85.72	92.07		
Right 120°	--	77.47	84.44	90.17		
Upward					(69)	
Left 150°	--	--	15.24	33.02	20, male	A right arm thumbtip reach 25° forward from vertical (127 cm above seat reference point), at specified angles to the subjects' right or left, in a plane at right angle to the seat reference vertical.
Left 60°	--	--	12.04	26.03		
Right 30°	--	--	35.36	50.80		
Right 120°	--	--	44.45	55.88		

References

(13) Damon, et al, from Kennedy, 1964, USAF. Courtesy: Harvard University Press
(69) Van Cott and Kinkade, from Kennedy, 1964, USAF

TABLE 10. BIOMECHANICS DATA SUMMARY - REACH ENVELOPE, AMPUTEES

Arm Configuration	Mean Arm Length (Normal)* (cm)	Mean Arm Length (Prosthetic) (cm)	Mean Normal Reach Volume* (cm^3)	Mean Prosthetic Reach Volume (cm^3)	Reference and N	Remarks
Below elbow Amputee	74.75	71.00	496,192	275,856	(50) 11, Male	Vertical/lateral reach envelope in the frontal plane.
Above elbow Amputee	72.75	69.75	482,496	87,248	(50) 11, Male	

* Subject's unamputated arm

Ref. (50) Rozier, Three dimensional workspace of the amputee, 1977

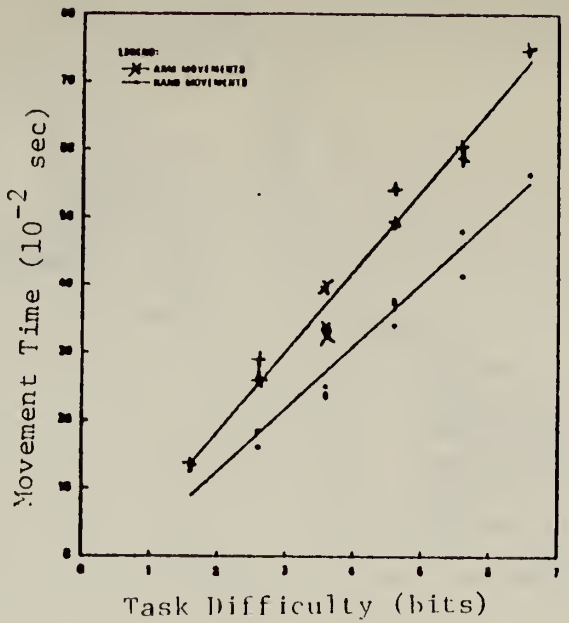
TABLE 11. BIOMECHANICS DATA SUMMARY - RANGE OF JOINT MOTION.

Joint and Movement (See Glossary)	Range (Degrees) 5th %tile	Mean	95th %tile	Reference and N	Remarks
Wrist				(13a), 39,	"Forced" move-
Flexion	70	90	110	Male	ments of fore-
Extension	78	99	120		arm about wrist
Total F and E	154	189	224		with hand
Adduction	12	27	42		restrained, more
Abduction	35	47	59		excursion than
Total Ad and Ab	53	74	95		normal hand about wrist motion.
Forearm					
Supination	77	113	149	(13a), 39,	Elbow at 90°
Pronation	38	77	116	Male	
Total S and P	141	190	239		
Elbow				(13a), 39,	
Flexion	126	142	158	Male	
Shoulder				(13a), 39,	
Flexion	168	188	208	Male	
Extension	38	61	84		
Total F and E	218	249	280		
Adduction	33	48	63		
Abduction	106	134	162		
Total Ad and Ab	149	182	215		
Rotation, Medial	61	97	133		
Rotation, Lateral	13	34	55		
Total RM and RL	92	131	170		
Ankle				(13a), 39,	
Flexion	23	35	47	Male	
Extension	18	38	58		
Total F and E	50	73	96		
Adduction	9	24	39		Or Inversion/
Abduction	11	23	35		Aversion
Total Ad and Ab	26	47	68		
Hip				(13a), 39,	
Flexion	92	113	134	Male	
Adduction	11	13	51		
Abduction	33	53	73		
Total Ad and Ab	61	84	107		
Rotation, Medial (Seated)	16	31	46		
Rotation, Lateral (Seated)	15	30	45		
Total R, M and L (Seated)	38	61	84		
Rotation, Medial (Prone)	23	39	55		
Rotation, Lateral (Prone)	18	34	50		
Total Rotation M and L (Prone)	47	73	99		

TABLE 11. BIOMECHANICS DATA SUMMARY - RANGE OF JOINT MOTION (CONTINUED).

Joint and Movement (See Glossary)	Range (Degrees) 5th %tile	Mean	95th %tile	Reference and N	Remarks
Knee				(13a), 29,	
Flexion (Standing)	92	113	134	Male	
Flexion (Kneeling)	144	139	174		
Flexion (Prone)	109	125	141		
Rotation, Medial	15	35	55		
Rotation, Lateral	23	43	63		
Total RM and RL	52	76	104		
Neck				(13d), 10, Male	
Flexion, Ventral	-	60	-		} Looking down
Flexion, Ventral		67		(13b), 100, Male + Female	
Flexion, Doral	-	61	-	(13d), 10, Male	} Looking up
Flexion, Dorsal	-	77	-	(13b), 100, Male + Female	
Flexion, Right or Left	-	41	-	(13d), 10, Male	Head inclined right or left
Rotation, Right or Left	-	79	-	(13d), 10, Male	Looking right or left
Rotation, Right	-	73	-	(13b), 100,	Looking right
Rotation, Left	-	74	-	Male + Female	Looking left
Handgrip (Right)				(13c), 79	Seated, grasping a
Flexion, Extreme	20	46	72	Male	vertical handgrip
Flexion, Comfortable	64	91	118		48.26 cm forward
Extension, Extreme	11	33.6	56		and 34.18 cm above
Extention, Comfortable	46	71.8	98		Seat Reference
Total, F-E, Comfortable	38	76.6	115		Point. Flexion
Total, F-E, Extreme	127	164.2	201		and extension were left and right, respectively, from comfortable "neutral."

(13a) Damon et al, from Barter et al, 1957
(13b) Damon et al, from Buck et al, 1959
(13c) Damon et al, from Daniels and Hertzberg, 1952
(13d) Damon et al, from Glanville and Kreezer, 1937

Activity	Type of Data	Data	Remarks
Hand vs. arm movement	Movement time vs. task difficulty in "bits" for arm movements and hand movements.	 Information Rates (bits/sec) for Rotary Hand and Arm Movements	Subject rotated a pointer between two target circles of varying width and varying distance apart on a circular scale, with minimum permissible error and both hand and arm movements
Ibid	Information rates (bits/sec) for hand movements vs. arm movements		Same test as above. Method of derivation of bits/sec data is not clear.

Subjects	Hand Movements	Arm Movements
1	6.7	7.9
2	9.3	10.3
3	24.9	12.4
4	12.3	6.9
5	12.8	6.4
Mean	13.2	8.28

Reference: (31) Kvalseth, 1976, male graduate students.

TABLE 13. BIOMECHANICS, MOTOR PERFORMANCE DATA SUMMARY--BLIND.

Activity	Data	Remarks
Manipulative Dexterity Testing--Blind		MRMT-Minnesota Rate of Manipulation Test--Moving blocks from hole to hole and turning blocks over in their holes. SCSIT-Southern California Sensory Integration Test (Kinesthesia Test)--Measures upper extremity joint position and movement perception with occluded vision Kinesthesiometer--measur ability to reproduce active and passive movements of the forearm with vision occluded.

Group	Measure	Kinesthesiometer (total degrees of error)		SCSIT Kinesthesia (Total millimeters of error)	MRMT (total seconds)		N
		Passive	Active		Displacing	Turning	
Blind	Mean	71.56	51.94	183.13	248.75	166.28	16
	SD	22.67	10.80	47.29	98.07	45.16	
Normally Sighted	Mean	58.75	40.63	177.88	226.44	158.96	16
	SD	14.81	11.18	33.22	55.98	21.48	

*Lower scores indicate greater accuracy.

Reference: (20) Elfant

TABLE 14 BIOMECHANIC MOTOR PERFORMANCE DATA SUMMARY - PLEGIC DEXTERITY

Activity	Paraplegics N = 80 male/female	Hemiplegics- Left Arm Paralysis N = 50 Male/Female	Hemiplegics- Right Arm Paralysis N = 50 Male/Female	Remarks
Manipulative tasks	Right Hand S.Score*	Right Hand S.Score*		*Standard Scope of 70 is lower limit of "able bodied range."
	Skill	Skill		Subtests:
	Pin Count 80	Pin Count 60		Card Sort - Place 5 x 8 cards in two stacks to right and left with right and left hand straight
	Peg Board 80	Peg Board 50		Pin Count - Pick up straight pins, one at a time
	Nuts and Bolts 90	Nuts and Bolts 11		Peg Board - Place pegs in holes and place washer and sleeve on peg.
	Card Sorting 93	Card Sorting 16		Nuts and Bolts - Screw on and remove nuts from fixed bolts
	Round Blocks 85	Round Blocks 57		Round Blocks - Pick up and turn blocks in hole
	Average Skill 85	Average Skill 44		Erector Set - Assemble an erector set truck, using screwdriver
	Strength	Strength		Coin Count - Remove coins one by one from purse
	Hand Grip Men 84	Hand Grip Men 67		Hand Tool - Bennet Hand Tool Dexterity Test (not described)
	Women 87	Women 75		Hand Grip - Preston Hand Dynamometer
	Left Hand	Age: 20-82, Mean 51	Left Hand S.Score*	
	Skill		Skill	
	Pin Count 78		Pin Count 70	
	Peg Board 85		Peg Board 60	
	Nuts and Bolts 88		Nuts and Bolts 77	
	Card Sorting 91		Card Sorting 60	
	Round Blocks 89		Round Blocks 74	
	Average Skill 86		Average Skill 68	
	Strength		Strength	
	Hand Grip Men 92		Hand Grip Men 78	
	Women 90		Women 89	
	Both Hands		Age: 30-75, Mean 50	
	Skill			
	Erector Set 77			
	Coin Count 93			
	Peg 89			
	Nuts and Bolts 83			
	Card Sorting 96			
	Hand Tool Test 91			
	Round Blocks 91			
	Average Skill 88			
	Age: 19 to 57, Mean NA			

Reference: (6) Bell et al (1976).

TABLE 15. BIOMECHANICS, MOTOR PERFORMANCE DATA SUMMARY - WALKING

Activity	Data					Remarks
		Elderly Group N = 23		Young Group N = 12		Mean Difference for Test Group
		Mean	S.D.	Mean	S.D.	
Walking patterns	Step length, cm	38.10	5.84	46.94	5.58	-8.8
	Cadence, steps per minute	109.4	12.5	105.4	9.2	+ 4.0
	Velocity, km per hour	2.53	0.51	2.95	0.39	-0.42
	Ratio of swing to support time	49.5%	4.2%	55.6%	3.3%	-6.1%

Instrumentation: Electrogoniometers, electromyographs. Also a tacograph and a conductive copper walkway.

Elderly

N = 23

Mean Age 74.40 yrs.
Height: 55.70 cm
Weight: 63.83 kg
Vertical height of CG: 92.22 cm
Ratio of CG to weight: 58.1%

Young

N = 12

Mean Age 29.9 yrs.
Height: 166.12 cm
Weight: 58.26 kg
Vertical height of CG: 93.77 cm
Ratio of CG to height: 56.0%

Reference: (21) Finley et al, 1969, elderly and young women.

TABLE 16 BIOMECHANICS DATA SUMMARY - GRIP STRENGTH

		Adult Male (13a)	Adult Male (13b)	Adult Male (13c)	Adult Male (13d)	Adult Male (33a)	Adult Male (69a)	Adult Male (69b)	Adult Female (13e)	Adult Female (33)	Old Male (13f)	Male 10 Yrs (43)	Female 10 Yrs (43)	Male 4 Yrs (43)	Female 6 Yrs (43)
Whole Hand Grip (Right or Preferred hand) (Newtons)* *lbs. x 4.45 or kiloponds x 9.80	(N)	(101)	(268)	(162)	(431)	(NA)	(NA)	(NA)	(96)	(31)	(118)	(16)	(12)	(32)	(25)
	Min.	-	-	-	-	-	-	-	-	-	-	135.24	94.08	43.12	34.30
	5th	444.50	404.95	396.05	471.70	387.82	262.55	436.10	283.65	196.98	155.75	-	-	-	-
	% 10th	-	-	-	-	-	-	-	-	-	-	136.22	107.80	67.62	55.86
	tile Mean	574.05	538.45	551.80	609.55	493.52	462.80	551.80	329.30	258.72	284.80	179.34	143.08	94.08	82.32
	90th	-	-	-	-	-	-	-	-	-	-	223.44	177.38	111.72	109.76
	95th	707.55	671.95	707.55	765.40	636.02	658.16	685.30	404.95	320.46	405.40	-	-	-	-
	Max.	-	-	-	-	-	-	-	-	-	-	256.76	189.14	135.24	127.40
Whole Hand Grip (Left hand) (Newtons)* *lbs. x 4.45 or kiloponds x 9.80	(N)	(101)	(268)	(162)	(431)		(NA)				(118)				
	Min.	-	-	-	-		-				-				
	5th	387.15	382.70	382.70	440.55		249.20				129.05				
	% 10th	-	-	-	-		-				-				
	tile Mean	525.10	502.85	342.90	587.40		418.30				262.55				
	90th	-	-	-	-		-				-				
	95th	658.60	623.00	707.55	747.60		596.30				396.05				
	Max.	-	-	-	-		-				-				

References:
(13a) Damon et al from Damon and McFarland, 1955, truck drivers
(13b) Ibid, Bus and truckdrivers
(13c) Damon et al from Damon and Stoudt, 1958, rubber industry workers
(13d) Damon et al from Damon et al, 1962, U.S. Army, male
(13e) Damon et al from Fisher and Burren, 1946, industrial workers
(13f) Damon et al from Damon and Stoudt, 1963, Spanish-American war veterans
(33) Laubach, 1975, students, female
(33a) Laubach from Laubach and McConville, 1969, college, male
(43) Owings et al, 1974, children
(69a) Van Cott and Kinkade from Barter et al, 1956, USAF personnel, military and civilian
(69b) Van Cott and Kinkade from Clauser et al, 1967, USAF, officer
Reference 13 courtesy: Harvard University Press.

TABLE 17. BIOMECHANICS DATA SUMMARY--PUSH-PULL.

Push-Pull Operation	Reference and N	Newtons			Remarks
		5th %tile	Mean	95th %tile	
					*Mean = mean of two trials **Peak = peak of two trials
Two handed vertical pull 38 cm level, from floor	(1) Women N = 349	Mean* 323.96 Peak** 396.95	Mean 559.14 Peak 636.35	Mean 816.13 Peak 888.65	Bends at knees and waist, pulls with legs, arms, shoulders
Two handed vertical pull 50 cm level, from floor	(1) Women N = 349	Mean 307.05 Peak 374.24	Mean 557.36 Peak 702.65	Mean 831.93 Peak 905.37	Knees straight, back bent, pull primarily with arms and shoulders
Two handed vertical pull 100 cm level, from floor	(1) Women N = 349	Mean 184.90 Peak 218.05	Mean 296.82 Peak 333.30	Mean 443.00 Peak 493.50	Back and knees straight, pull with arms
Two handed vertical push 150 cm level, from floor	(1) Women N = 349	Mean 151.97 Peak 187.79	Mean 248.33 Peak 287.47	Mean 377.14 Peak 430.31	Push up with arms and shoulders
One handed vertical pull 100 cm level, from floor	(1) Women N = 349	Mean 104.57 Peak 131.72	Mean 180.00 Peak 214.49	Mean 282.00 Peak 822.62	Erect, pulls with arm on dominant side
Two handed forward push 110 cm level, from floor	(47) Women N = 152	133.50 223.83	Average Plateau 296.81 Maximum Force 432.05*	569.60 789.87	Flexed arm push with flexed knees

Push-Pull Operation	Reference and N	Newtons 5th %tile	Mean	95th %tile	Remarks
					*Mean = mean of two trials **Peak = peak of two trials
Two handed vertical pull 25 cm level, from floor	(47) Women N = 152	210.48	Average Plateau 495.73*	948.25	Squatting lift
		244.75	Maximum Force 582.50	1125.85	
Two hand vertical pull 50 cm level, from floor	(47) Women N = 152	279.01	Average Plateau 643.91**	1144.58	Legs straight, back lift
		283.91	Maximum Force 726.68**	1269.58	
Two hand vertical push 100 cm level, from floor	(47) Women N = 152	139.73	Average Plateau 849.77**	737.36	Legs and torso straight, arm lift
		(probably erroneous entry)	Maximum Force 401.83	766.29	
Push lever	(11), 6 yr Male N = 50	131	209	281*	Generally erect, but body, foot position and number of hands in grip varied spontaneously by all subjects for all push/pull tests in this reference. Data are rounded to nearest newton. *Computed by Mean + 2 SD by author.
Pull lever	(11), 6 yr Male N = 50	171	250	296	
Push lever	(11), 6 yr Female N = 50	111	175	357*	
Pull lever	(11), 6 yr Female N = 50	145	224	282	

TABLE 17. BIOMECHANICS DATA SUMMARY--PUSH-PULL (CONTINUED)

Push-Pull Operation	Reference and N	Newtons			Remarks
		5th %tile	Mean	95th %tile	
					*Mean = mean of two trials **Peak = peak of two trials
Pull, across chest	(12), 6 yr Male N = NA	54.7	85.8	122.8	Pulled handles across chest, horizontally in opposite directions
Pull, across chest	(12), 6 yr Female N = NA	54.7	81.8	112.1	
Pull, perpendicular	(12), 6 yr Male N = NA	52.0	79.2	100.1	Direction of pull is not entirely clear from reference but is probably a combination of vertical and outward pull at chest level which may, in fact, be a push.
Pull, perpendicular	(12), 6 yr Male N = NA	54.7	73.8	94.3	

References

(1) U.S. Army, Natick, 1977, Army Women
(11) Brown and Buchanan, 1973, Children
(12) Brown and Buchanan, 1974, Children
(47) Reynolds and Allgood, 1975, Airline Stewardesses

TABLE 18 BIOMECHANICS DATA SUMMARY--WHOLE BODY PUSH

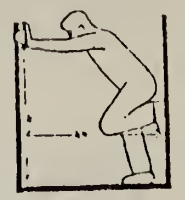
Push Configuration	Force Plate Height	Distance From Brace Point	Men (69) N=30-43 (Newtons) 5th %tile	Men (69) N=30-43 (Newtons) Mean	Men (69) N=30-43 (Newtons) 95th %tile	Women (33) N=31 (Newtons) 5th %tile	Women (33) N=31 (Newtons) Mean	Women (33) N=31 (Newtons) 95th %tile	Remarks
Position 1									
Straight Reach, Both Palms with Foot Brace	50	80		663.05		NA	NA	NA	
	50	100		774.30					
	50	120		778.75					
	70	80		716.45					
	70	100		729.80					
	70	120		818.80					
	90	80		627.45					
	90	100		676.40					
	90	120		863.30					
	percent of acromial height								
Position 2									
Shoulder with Foot Brace	60	70		760.95					
	60	80		854.40		198.94	380.24	561.54	
	60	90		792.10					
	70	60		578.50					
	70	70		698.65					
	70	80		725.35					
	80	60		520.65					
	80	70		618.55					
	80	80		636.35					
	percent of acromial height								
Position 3									
Flexed Reach, Both Palms with Foot Brace	70	70		623.00		117.60	228.24	350.84	
	70	80		689.75					
	70	90		587.40					
	80	70		547.35					
	80	80		542.90					
	80	90		534.00					
	90	70		431.65					
	90	80		449.45					
	90	90		485.05					
	percent of acromial height								

TABLE 18 BIOMECHANICS DATA SUMMARY--WHOLE BODY PUSH (CONTINUED)

Push Configuration	Force Plate Height	Distance From Brace Point	Men(12) N=30-43 (Newtons) 5th %tile	Mean	95th %tile	Women(6) N=31 (Newtons) 5th %tile	Mean	95th %tile	Remarks
Position 4									
Whole Back Push, Squat, with Palm & Knee Brace	40 percent of acromial height	80		1904.60		265.58	674.24	1062.90	
		90		1619.80					
		100		1655.40					
		110		1931.30					
		120		1962.45					
		130		1766.65					
		percent of thumb-tip reach							
Position 5									
				Both Hands					
Flexed Reach, Palm with Back Brace	100 percent of acromail height	50		582.95					
		60		667.50					
		70		983.45					
		80		1286.05		246.96	549.78	852.60	
		90		979.00					
		100		645.25					
				Preferred Hand					
		50		262.55					
		60		298.15					
		70		360.45					
		80		520.65		122.50	245.00	367.50	
		90		493.95					
		100		427.20					
		percent of thumb-tip reach							
Position 6									
Extended Lateral Palm Push with Extended Lateral Palm Brace	100 percent of acromial height	50		369.35					
		60		347.10		NA	NA	NA	
		70		520.65					
		80		707.55					
		90		324.85					
		percent of span							

References: (31) Laubach, 1976
(69) Van Cott & Kinkade from Kroemer, 1968

TABLE 19. BIOMECHANICS DATA SUMMARY--SAFE MANUAL FORCE APPLICATION.

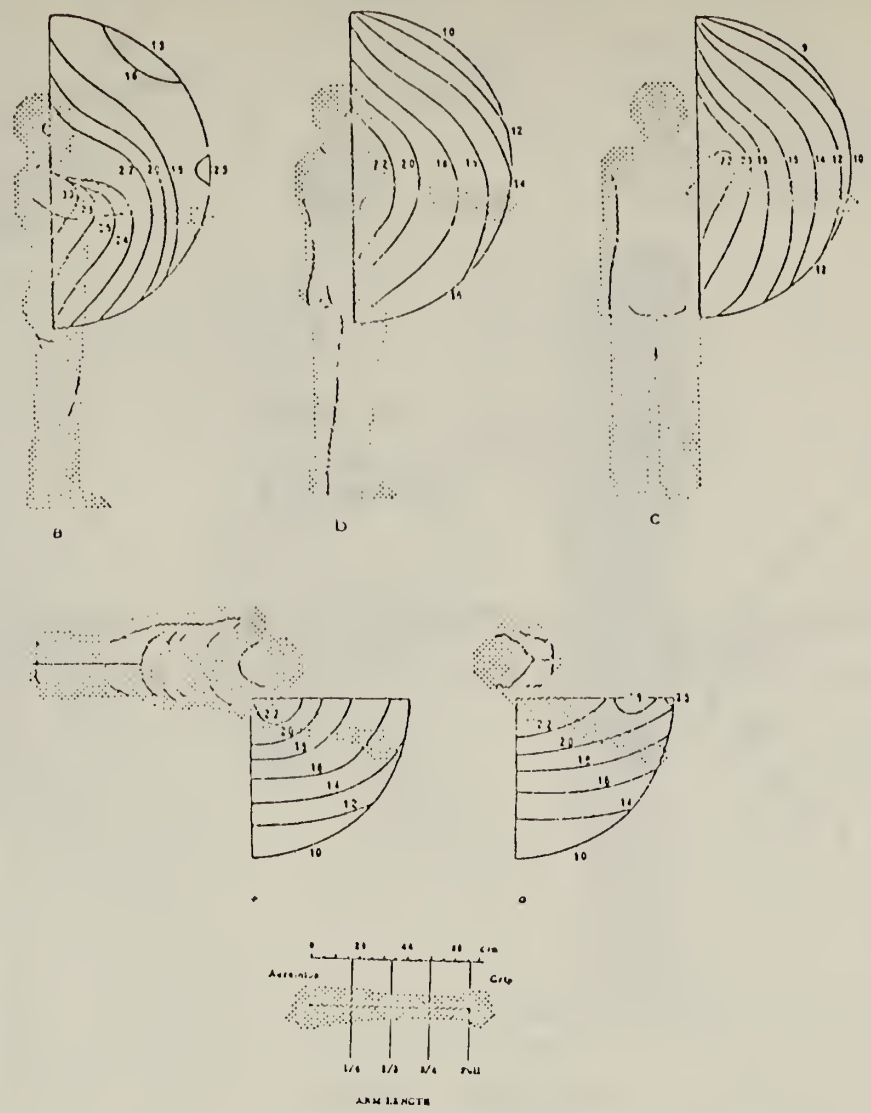
Operation, Reference, N	Applied Loads (kg)	Remarks
One-handed pushes forward horizontally away from the body (14a) Davis and Stubbs, 1977 N=12, young adult males		Codes for positions and viewing perspectives are as follows: A. Arms directly in front of body (Sagittal plane) C. Arms held out sideways from the body (Coronal plane) B. Arms halfway between A & C (Abducted to 45° from the Sagittal plane) + Seen from above and behind with the hands in a plane 45° above the horizontal and passing through the shoulder o Seen from directly above with the hands in a plane 45° below the horizontal and passing through the shoulders - Not defined for these data

TABLE 19. BIOMECHANICS DATA SUMMARY--SAFE MANUAL FORCE APPLICATION (CONTINUED).

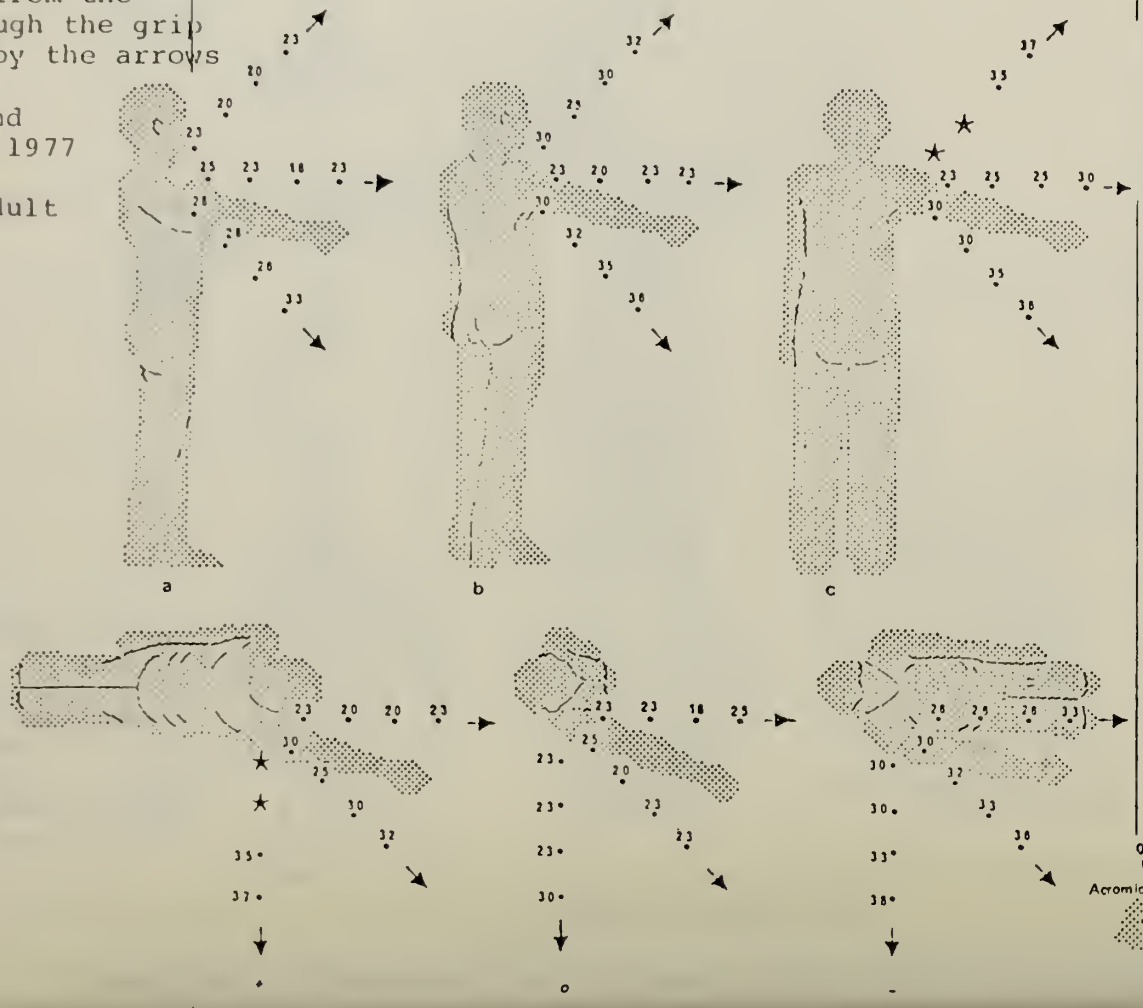
Operation, Reference, N	Applied Loads (kg)	Remarks
One-handed pushes away from the shoulder, standing or squatting with back erect. The force vector is always in the line passing from the shoulder through the grip as indicated by the arrows (14b) Davis and Stubbs, 1977 N=12, young adult male		Codes for positions and viewing perspective are as follows A. Arms directly in front of body (Sagittal plane) C. Arms held out sideways from body (Coronal plane) B. Arms halfway between A & C (Abducted to 45° from the Sagittal plane) + Seen from directly above and behind with the hands in a plane 45° above the horizontal and passing through the shoulder. o Seen from directly above with the hands in the horizontal plane passing through the shoulder. - Seen from above and in front with the hands in a plane 45° below the horizontal and passing through the shoulders. *The hand cannot perform this action in the positions indicated by stars.

TABLE 19. BIOMECHANICS DATA SUMMARY--SAFE MANUAL FORCE APPLICATION (CONTINUED).

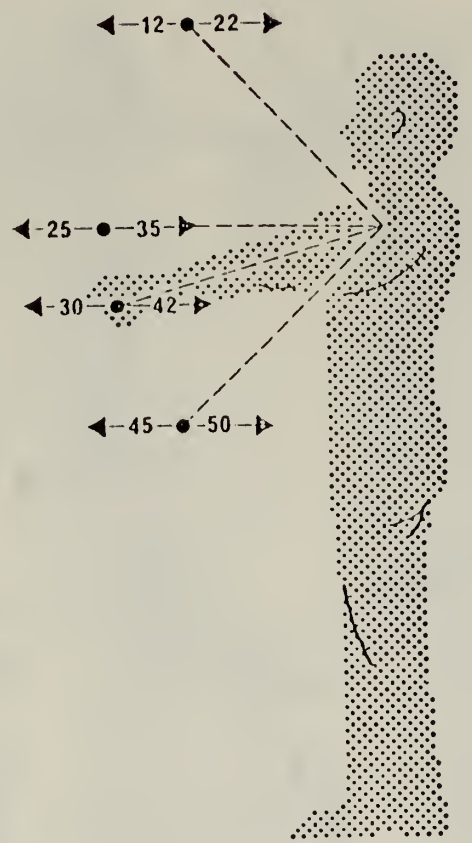
Operation, Reference, N	Applied Loads (kg)	Remarks
Two-handed pushes forward horizontally away from the body, and two-handed pulls horizontally towards the body with the hands in front of the body, standing or squatting with back erect. (14b) Davis and Stubbs, 1977 N=12, young adult males		

TABLE 19. BIOMECHANICS DATA SUMMARY - SAFE MANUAL FORCE APPLICATION (CONTINUED).

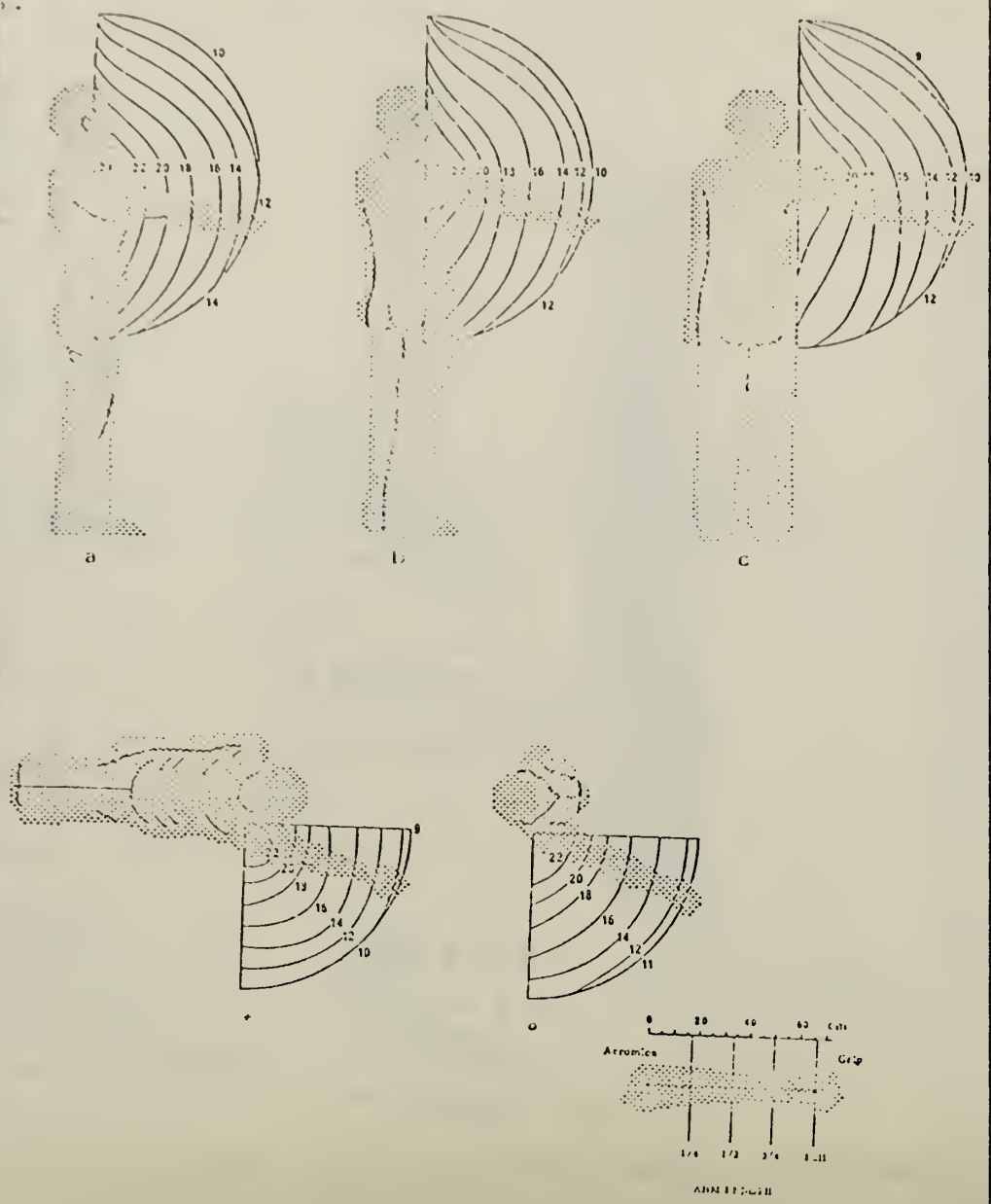
Operation, Reference, N	Applied Loads (kg)	Remarks
One-handed palmar thrusts. In all cases the force exerted by the palm is horizontal, and at right angles to the line from the shoulder through the gap. In the diagrams the vector of thrust will appear to be directly away from the reader. (14a) Davis and Stubbs, 1977 N=12 young male adults		Codes for positions and viewing perspectives are as follows: A. Arms directly in front of body (Sagittal plane) C. Arms held out sideways from the body (Coronal plane) B. Arms halfway between A & C (Abducted to 45° from the Sagittal plane) + Seen from above and behind with the hands in a plane 45° above the horizontal and passing through the shoulder. o Seen from directly above with the hands in a plane 45° below the horizontal and passing through the shoulders - Not defined for these data.

TABLE 19. BIOMECHANICS DATA SUMMARY--SAFE MANUAL FORCE APPLICATION (CONTINUED).

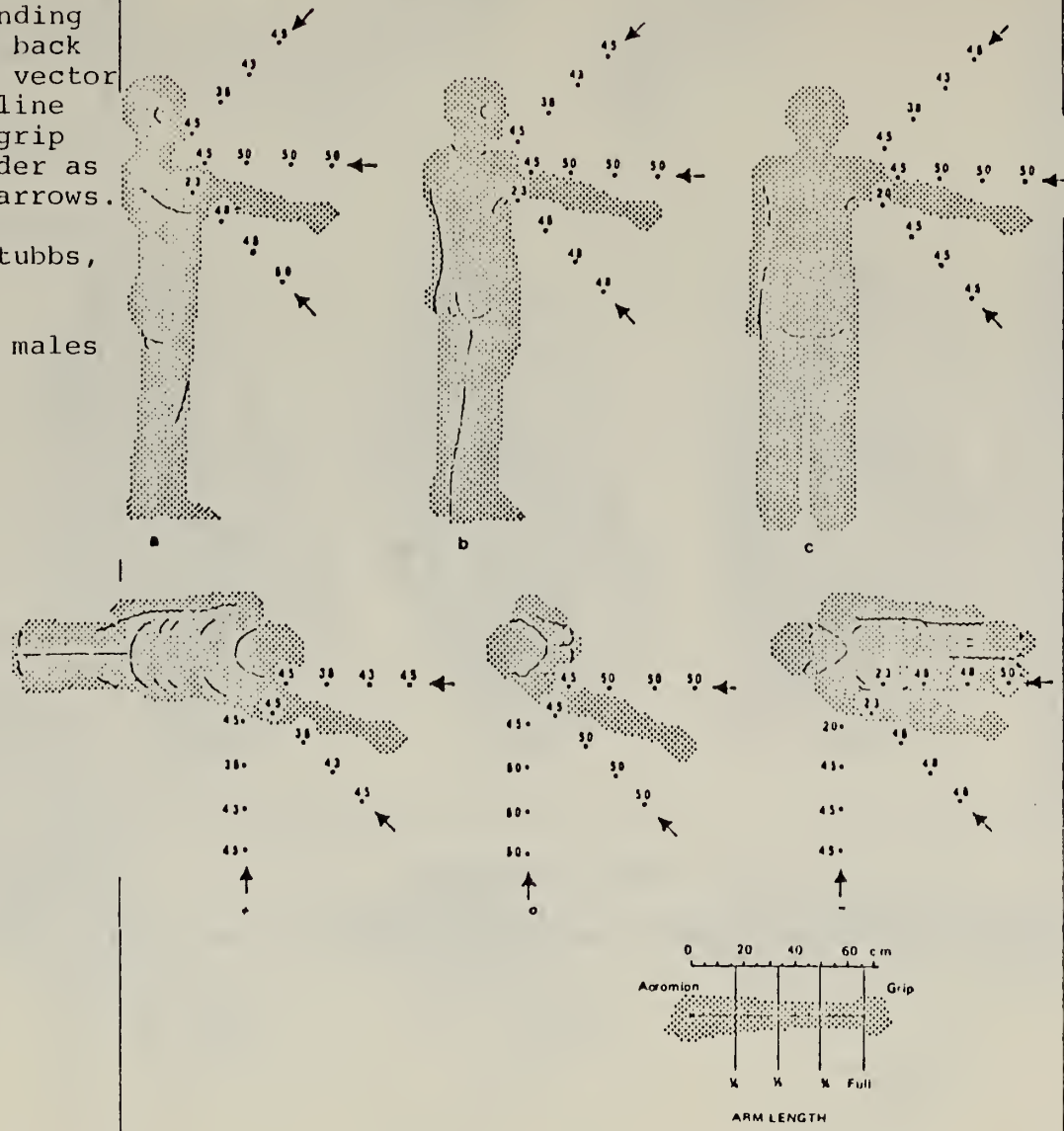
Operation, Reference, N	Applied Loads (kg)	Remarks
One-handed pulls towards the shoulder, standing or squatting with back erect. The force vector is always in the line passing from the grip through the shoulder as indicated by the arrows. (14b) Davis and Stubbs, 1977 N=12, young adult males		Codes for positions and viewing perspectives are as follows: A. Arms directly in front of body (Sagittal plane) C. Arms held out sideways from body (Coronal plane) B. Arms halfway between A & C (Abducted to 45° from the Sagittal plane) + Seen from directly above and behind with the hands in a plane 45° above the horizontal and passing through the shoulder. o Seen from directly above with the hands in the horizontal plane passing through the shoulder. - Seen from above and in front with the hands in a plane 45° below the horizontal and passing through the shoulders.

TABLE 19. BIOMECHANICS DATA SUMMARY--SAFE MANUAL FORCE APPLICATION (CONTINUED).

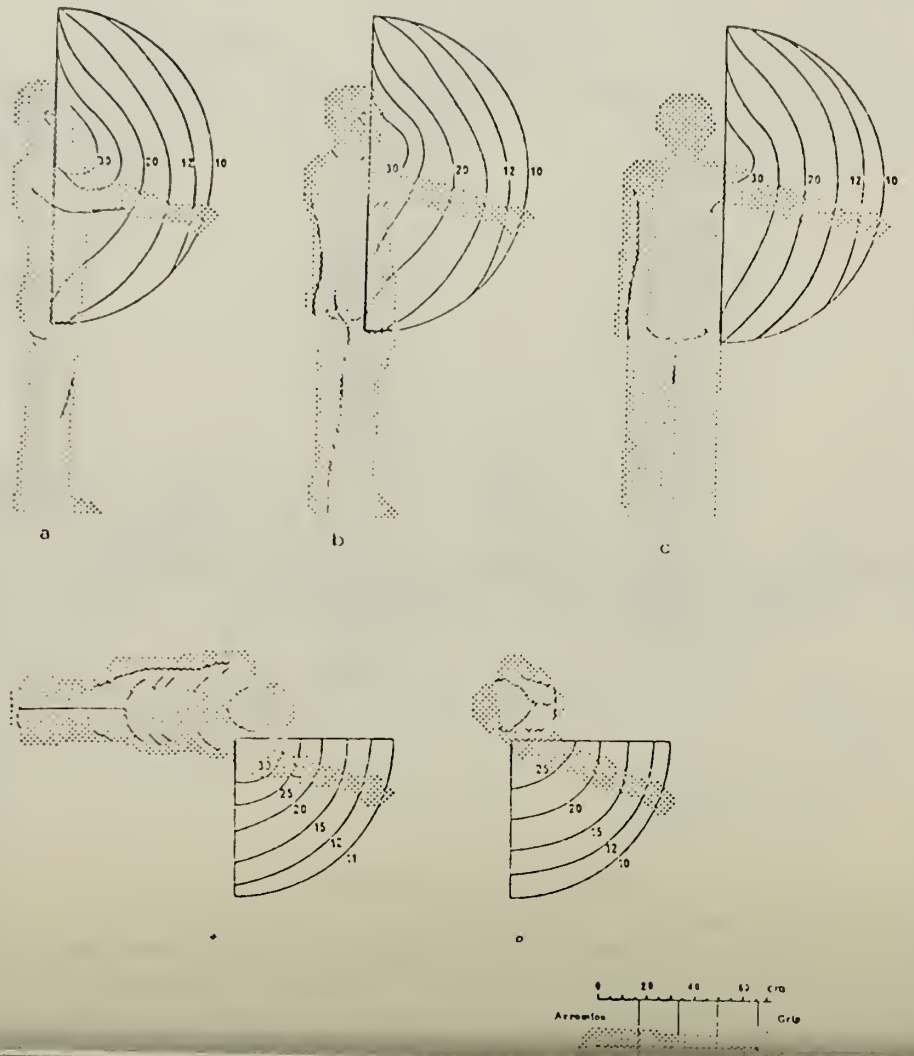
Operation, Reference, N	Applied Loads (kg)	Remarks
One-handed vertical lifts (14a) Davis and Stubbs, 1977 N=12, young adult males		Codes for positions and viewing perspectives are as follows: A. Arms directly in front of body (Sagittal plane) C. Arms held out sideways fron the body (Coronal plane) B. Arms halfway between A & C (Abducted to 45° from the Saigttal plane) + Seen from above and behind with the hands in a plane 45° above the horizontal and passing through the shoulder. o Seen from directly above with the hands in a plane 45° below the horizontal and passing through the shoulders. - Not defined for these data.

TABLE 19. BIOMECHANICS DATA SUMMARY--SAFE MANUAL FORCE APPLICATION (CONTINUED).

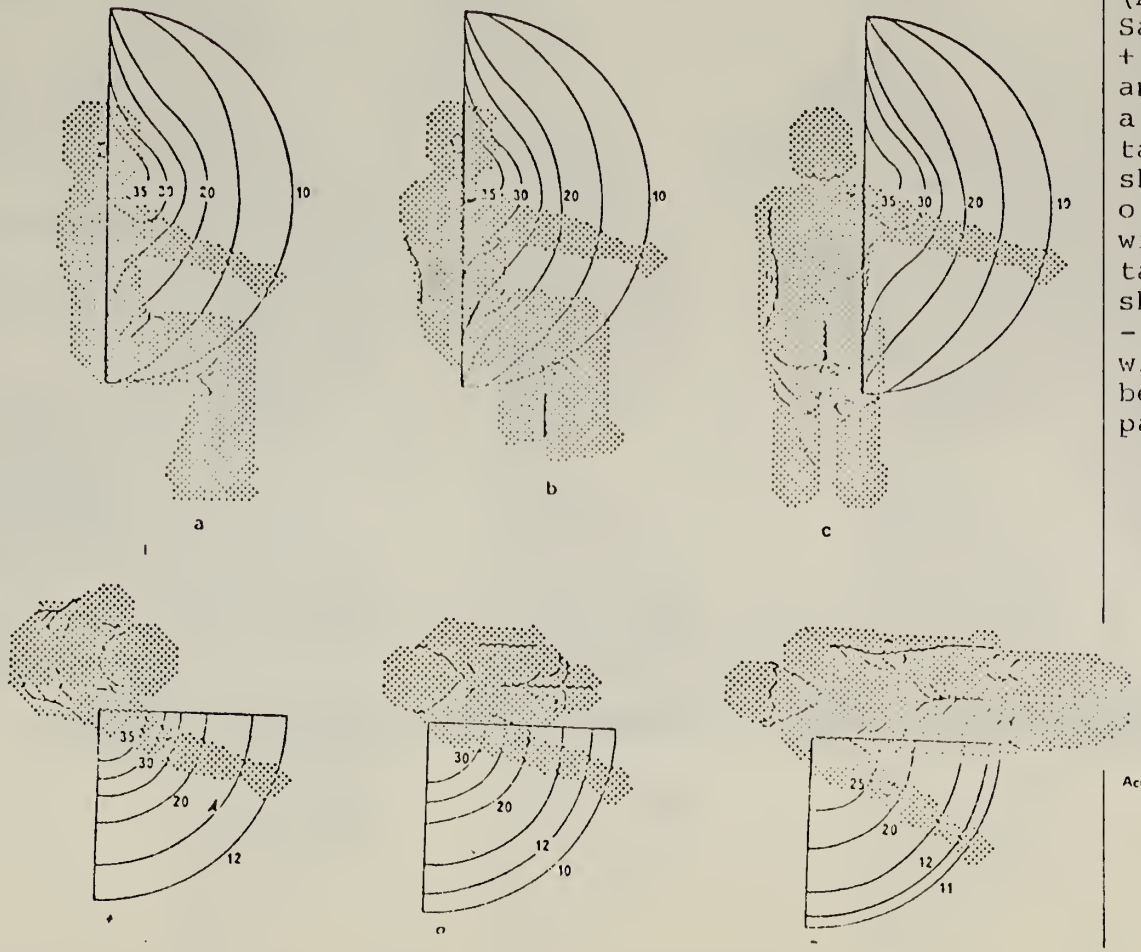
Operation, Reference, N	Applied Leads (kg)	Remarks
One-handed vertical lifts, sitting without a back-rest. (14b) Davis and Stubbs, 1977 N=12, young adult males		Codes for positions and viewing perspectives as follows: A. Arms directly in front of body (Sagittal plane) C. Arms held out sideways from body (Coronal plane) B. Arms halfway between A & C (Abducted to 45° from the Sagittal plane) + Seen from directly above and behind with the hands in a plane 45° above the horizontal and passing through the shoulder. o Seen from directly above with the hands in the horizontal plane passing through the shoulder. - Seen from above and in front with the hands in a plane 45° below the horizontal and passing through the shoulder.

TABLE 19. BIOMECHANICS DATA SUMMARY--SAFE MANUAL FORCE APPLICATION (CONTINUED).

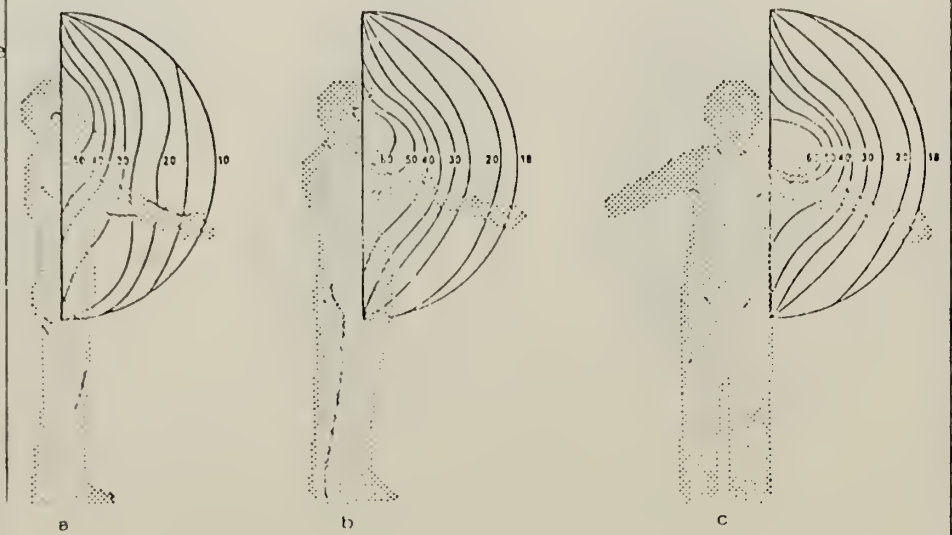
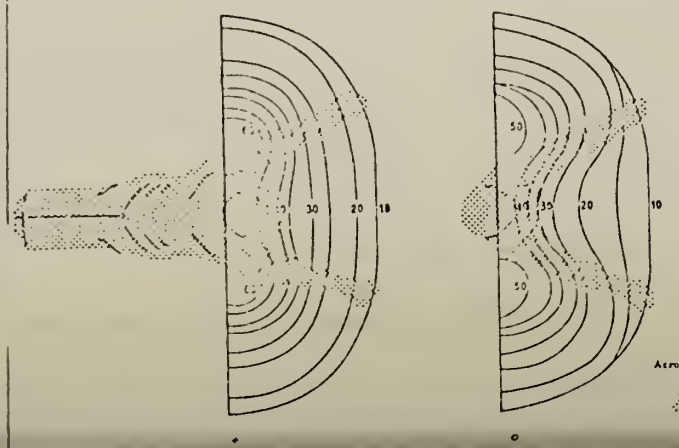
Operation, Reference, N	Applied Loads (kg)	Remarks
Two handed vertical lifts with the weights shown divided equally between the two hands and with the hands in similar positions on either side of the body. (14a) Davis and Stubbs, 1977 N=12, young adult males	  	Codes for positions and viewing perspectives are as follows: A. Arms directly in front of body (Sagittal plane) C. Arms held out sideways from the body (Coronal plane) B. Arms halfway between A & C (Abducted to 45° from the Sagittal plane) + Seen from above and behind with the hands in a plane 45° above the horizontal and passing through the shoulder o Seen from directly above with the hands in a plane 45° below the horizontal and passing through the shoulders. - Not defined for these data.

TABLE 19. BIOMECHANICS DATA SUMMARY--SAFE MANUAL FORCE APPLICATION (CONTINUED).

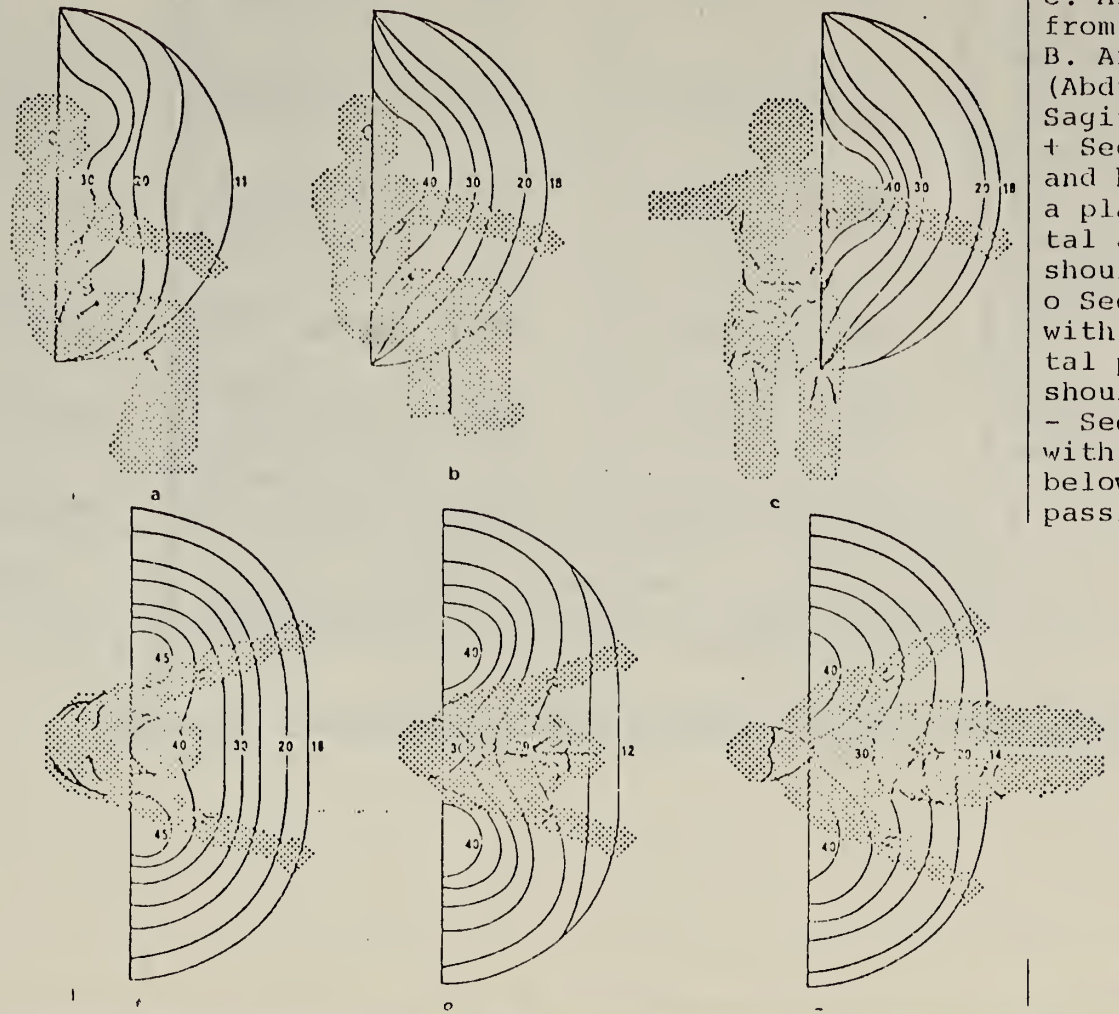
Operation, Reference, N	Applied Loads (kg)	Remarks
Two-handed vertical lifts with the weights shown divided equally between the two hands and with the hands in similar positions on either side of the body, sitting without a backrest. (14b) Davis and Stubbs, 1977 N = 12, young adult males		Codes for position and viewing perspectives and as follows: A. Arms directly in front of body (Sagittal plane) C. Arms held out sideways from body (Coronal plane) B. Arms halfway between A & C (Abducted to 45° from the Sagittal plane) + Seen from directly above and behind with the hands in a plane 45° above the horizontal and passing through the shoulder. o Seen from directly above with the hands in the horizontal plane passing through the shoulder. - Seen from above and in front with the hands in a plane 45° below the horizontal and passing through the shoulders.

TABLE 20. BIOMECHANICS DATA SUMMARY--LIFTING, USER ACCEPTANCE.

Lifting Criteria	Reference and N	Kg. 5th %tile	Kg. Mean	Kg. 95th %tile	Remarks
Maximum weight lifted to 30.48 cm	(33) Male N-NA	64.33	104.64	136.35	Weighted ammunition case, 64.77 X 27.30 X 13.24 cm, lifted from floor to platform
Maximum weight lifted to 91.44 cm	(33) Male N-NA	34.81	53.91	77.92	
Maximum weight lifted to 152.40 cm	(33) Male N-NA	16.31	26.27	37.60	
Maximum reasonable weight, one hand carry	(30) Male 16-29, N = 16	9.62	18.20	26.78	Data are for 30.5 cm cubical box weighted with shot by subjects to "Maximum Reasonable Weight." 95th and 5th percentile values are from Mean + 1.65 S.D. The Mean and 5th percentile values for females may be high since the distribution for females was positively skewed because the empty box was heavier than "maximum reasonable weight" for some female subjects. 5th percentile is equivalent to 95% of population acceptability data shown elsewhere in this table.
	(30) Male 30-34 N = 16	8.17	18.40	28.63	
	(30) Male 45-60 N = 16	10.99	19.70	28.11	
	(30) Female 16-29 N = 16	8.42	13.20	17.98	
	(30) Female 30-44 N = 16	4.76	13.50	22.24	
	(30) Female 45-60 N = 16	7.22	12.50	17.78	

TABLE 20. BIOMECHANICS DATA SUMMARY--LIFTING, USER ACCEPTANCE (CONTINUED).

Lifting Criteria	Reference and N	Kg. 5th %tile	Kg. Mean	Kg. 95th %tile	Remarks
Maximum reasonable weight, two hand carry	(30) Male 16-29 N = 10	14.36	23.60	32.84	Data are for 30.5 cm cubical box weighted with shot by subjects to "Maximum Reasonable Weight." 95th and 5th percentile values are from Mean ± 1.65 S.D. The Mean and 5th percentile values for females may be high since the distribution for females was positively skewed because the empty box was heavier than "maximum reasonable weight" for some female subjects. 5th percentile is equivalent to 95% of population acceptability data shown elsewhere in this table
	(30) Male 30-44 N = 16	11.60	21.50	31.40	
	(30) Male 45-60 N = 16	14.72	22.70	30.78	
	(30) Female 16-29 N = 16	9.67	16.10	22.53	
	(30) Female 30-44 N = 16	9.57	16.00	22.43	
	(30) Female 45-60 N = 16	8.69	14.30	19.91	

TABLE 20. BIOMECHANICS DATA SUMMARY--LIFTING, USER ACCEPTANCE (CONTINUED).

Lifting Criteria	Reference and N	Population % for Weight (kg) Acceptability*							Remarks
		95	90	75	50	25	10	5	
Maximum acceptable weights for repeated lift, floor to knuckle height.	(30a) Male N = 28	--	17	21	25	29	32	--	*Percent of population for which a given weight was no greater than the maximum acceptable.
Maximum acceptable weights for repeated lift, knuckle to shoulder height.	(30a) Male N = 28	--	16	20	24	28	32	--	
Maximum acceptable weights for repeated lift, shoulder height to arm reach.	(30a) Male N = 28	--	13	18	22	27	31	--	Two handed repetitive lift of industrial tote box, 34.3 cm X 48.3 cm X 14.0 cm, evenly loaded with lead shot.
Maximum acceptable weights for repeated lift, floor to knuckle height.	(30b) Female Industrial N = 15	--	13	15	17	19	21	--	
Maximum acceptable weights for repeated lift, knuckle height to shoulder height.	(30b) Female Industrial N = 15	--	11	13	15	17	19	--	
Maximum acceptable weights for repeated lift, shoulder height to extended arm height.	(30b) Female Industrial N = 15	--	11	12	13	15	16	--	
Maximum acceptable weights for repeated lift, floor to knuckle height.	(30b) Female Housewives N = 16	--	6	8	10	11	12	--	

TABLE 20. BIOMECHANICS DATA SUMMARY--LIFTING, USER ACCEPTANCE (CONTINUED).

Lifting Criteria	Reference and N	Population % for Weight (kg) Acceptability 95	90	75	50	25	10	5	Remarks
Maximum acceptable weights for repeated lift, knuckle height to shoulder height.	(30b) Female Housewives N = 16	--	7	8	10	11	12	--	*Percent of population for which a given weight was no greater than the maximum acceptable.
Maximum acceptable weight weight for repeated lift shoulder height to extended arm reach.	(30b) Female Housewives N = 16	--	6	7	8	10	11	--	Two handed repetitive lift of industrial tote box, 34.3 cm X 48.3 cm X 14.0 cm, evenly loaded with lead shot.
"Maximum reasonable weight" for one hand carry	(30) Male 16-60++ N = 48	11.0	12.1	14.8	18.4	22.1	26.1	28.0	Subjects loaded box with shot to an acceptable weight for lifting and carrying over a level course and up a flight of steps.
"Maximum reasonable weight" for one hand carry	(30) Female 16-60+ N = 48	8.1	9.0	10.4	12.7	15.2	17.9	21.2	
"Maximum reasonable weight" for two hand carry	(30) Male 16-60+ N = 48	13.1	15.6	18.3	22.0	25.1	28.4	32.0	
"Maximum reasonable weight" for two hand carry	(30) Female 16-60+ N = 48	9.4	10.8	12.8	14.7	18.6	20.6	21.4	

References: (30) Kramer and Meguire, 1976
(30a) Kramer and Meguire, from Snook, et al, 1970
(30b) Kramer and Meguire, from Snook and Circello, 1974
(33) Laubach, 1976

HOME SAFETY

TABLE 21. HOME SAFETY DATA SUMMARY--ACCIDENT BACKGROUND--PERSONAL FACTORS.

Accident Factor, Reference, N	Significant Correlations: Factors--Accidents			Remarks
Various background factors related to accidents for standardized tasks; (25) Guilford, 1973; N = 226 women, mean age 37 years	Factors	Correlation P < .05	Correlation P < .01	A series of kitchen tasks were standardized in such a way that every subject was required to perform the same operations. Operations were selected to maximize accident potential and, at the same time, also to maximize the opportunity for accident-avoiding behavior. Tasks involved baking cupcakes; hardboiling four eggs; preparing a bacon, lettuce and tomato sandwich on toast; preparing cole slaw; serving two lunches; washing all dishes and utensils; washing nylons and a blouse; ironing the blouse; putting everything away; and cleaning the kitchen. The average time required for these tasks was 2 hours. Scores were number of personal injury accidents, property damage accidents, total accidents, near accidents.
	Demographic			
	Marital Status (Ever married)	-.15		
	No. Children		-.21	
	No. Children under 18		-.25	
	Driver's License		-.24	
	Drug Usage			
	Tranquilizers	-.14		
	Alcohol	-.13		
	Visual Acuity			
	Right eye, far	-.15		
	Right eye, near		-.19	
	Left eye, near	-.15		
	Both eyes, far	-.15		
	Both eyes, near		-.21	
	Stereopsis, near		-.17	

TABLE 21. HOME SAFETY DATA SUMMARY--ACCIDENT BACKGROUND--PERSONAL FACTORS (CONTINUED).

Accident Factor, Reference, N	Significant Correlations: Factors--Accidents		Remarks
	Handles plugged-in appliances with wet hands	.17	
	Grabs sharp knife by blade	.17	
	Climbs on object other than step stool	.21	
	Carries four eggs in hands	.20	
	Pours bleach directly on clothes	.20	
	Presses bacon with fingers in hot pan	.20	
	Lets iron cord dangle on floor	.14	
	Holds object in hand while climbing	.13	
	Unplugs toaster by pulling on cord	-.19	
	Wipes knife blade with fingers	-.15	
	Safe Practices		
	Turns iron off before unplugging	-.23	
	Checks to see if beaters are firmly set before turning on mixer	-.16	
	Unplugs iron immediately when through	.14	

TABLE 21. HOME SAFETY DATA SUMMARY--ACCIDENT BACKGROUND--PERSONAL FACTORS (CONTINUED).

Accident Factor, Reference, N	Significant Correlations: Factors--Accidents		Remarks
	Picture Completion*	-.19	*Picture completion test of Weschler Adult intelligence scale (for perceptual speed (attention to detail).
	Temperament**		**Derived from various pencil and paper "personality" type tests.
	Emotional Stability	-.15	
	Hypochondriasis	17	
	Nervousness (rating)	.15	
	Kitchen task behavior:		
	Using correct tools		Reference does not list behavior items in detail unless a significant correlation was found.
	Paper cups in muffin tin	-.22	
	Only rubber spatula in mixing	-.22	
	Used cutting board	-.15	
	Paring knife for carrot sticks	-.15	
	Correct soap to wash dishes	-.16	
	Unsanitary Practices		
	Guts or uses dropped food	.22	
	Coughs without covering mouth	.23	
	Uses same material to wipe floors and counters	.18	
	Puts away dirty object	..22	
	Unsafe practices		
	Cuts bacon in hot pan	.17	
	Uses cutting board in slot	..24	
	Lays hot iron flat down	.17	

TABLE 22. HOME SAFETY DATA SUMMARY--ACCIDENT BACKGROUND--EXERCISE LEVEL.

Accident Factor, Reference, N	% Control (No Injuries) vs Code (Injuries) Households				Remarks
Personal activity, (68) Tokuhata et al, 1973, household member interview	Activity Level	Control		Code	Individuals with accidents tended to have a higher level of exercise than those with no accidents.
		N	%	N	%
	Very active	1290	13.6	199	27.6
	Fairly Active	1720	18.2	154	21.4
	Not too active	1364	14.4	90	12.5
	Very Inactive	5075	53.6	278	38.5
	Unknown	15	0.2	--	--
	Total	9464	100.0	721	100.0

TABLE 23. HOME SAFETY DATA SUMMARY--ACCIDENT BACKGROUND--PRODUCT QUALITY.

Accident Factor, Reference, N	% Control (No injuries) vs Code (Injuries) Household					Remarks
Product quality practices, (68) Tokuhata et al, 1973, household members interviews		Control			Code	Households with injuries were more likely to answer "yes" than those with no injuries.
	Purchased reconditioned product	N	%	P.	N	%
	Yes	182	6.0	<.01	92	12.2
	No	2873	94.0		659	87.7
	NI	--	--		1	0.1
	Total	3055	100.0		752	100.0
	Purchase of blemished product					
	Yes	138	4.5	<.01	57	7.6
	No	2917	95.5		694	92.3
	NI	--	--		1	0.1
	Total	3055	100.00		752	100.0
	Assembly of household products by accident					
	Yes	1330	43.5	<.001	475	63.2
	No	1716	56.2		276	36.7
	NI	9	0.3		1	0.1
	Total	3055	100.0		752	100.0

TABLE 23. HOME SAFETY DATA SUMMARY--ACCIDENT BACKGROUND--PRODUCT QUALITY (CONTINUED).

Accident Factor, Reference, N	% Control (No injuries) vs Code (Injuries) Households					Remarks
		Control		Code		Households with injuries were more likely to answer "always by self" than those with no injuries.
Repair of household products	N	%	P.	N	%	
By specialist	1205	39.4		218	29.0	
Minor by self	848	27.8		226	30.1	
Always by self	7.7	23.5	<.01	238	31.6	
Discard small products	269	8.8		65	8.6	
Other	3	0.1		3	0.4	
NI	13	0.4		2	0.3	
Total	3055	100.0		752	100.0	

TABLE 24. HOME SAFETY DATA SUMMARY--ACCIDENT BACKGROUND--TOBACCO.

Accident Factor, Reference, N	% Control (No injuries) vs Code (Injuries) Households					Remarks
Tobacco use, (68) Tokuhata et al 1973, household member interviews		Control			Code	Individuals smoking cigarettes and cigars were more likely to have had injuries than those who did not do so. This does not hold for pipes.
	Cigarettes	N	%	P.	N	%
	Yes	2890	39.1	<.01	232	47.5
	No	3748	50.8		200	41.0
	Ex-smoker	319	4.3		24	4.9
	Unknown	430	5.8		32	6.6
	Total	7387	100.0		488	100.0
	Pipe					
	Yes	493	6.7		38	7.8
	No	6388	86.5		410	84.0
	Ex-smoker	15	0.2		1	0.2
	Unknown	491	6.6		39	8.0
	Total	7387	100.0		488	100.0
	Cigar					
	Yes	481	6.5	<.02	49	10.0
	No	6407	86.8		400	82.0
	Ex-smoker	9	0.1		--	--
	Unknown	490	6.6		39	8.0
	Total	7387	100.0		488	100.0

TABLE 25. HOME SAFETY DATA SUMMARY--ACCIDENT BACKGROUND--ALCOHOL CONSUMPTION, BACKGROUND.

Accident Factor, Reference, N	Number and % of Home Accidents Above Level			Remarks
Breathalyzer level above 0.01% (79) Weschler et al, 1967, Emergency Service, Massachusetts General Hospital	Sex	N	%	
	Men	267	31.5	
	Women	353	15.3	
	Age (yrs)			
	16-25	177	19.2	
	26-45	199	25.1	
	46-65	134	23.9	
	66 +	110	20.0	
	Marital Status			
	Single	218	24.8	
	Married	286	19.2	
	Widowed, divorced, separated	113	25.7	
	Social Class*			
	I and II (high)	82	13.4	
	III	97	21.6	
	IV	193	20.7	
	V (low)	203	26.1	

TABLE 26. HOME SAFETY DATA SUMMARY--ACCIDENT BACKGROUND--ALCOHOL USE.

Accident Factor, Reference, N	% Control (No injuries) vs Code (Injuries) Households				
Drinking activity, (68) Tokuhata et al, 1973, Household resident interview		Control			Code
	Wine	N	%	P	N	%
	Yes	3073	41.9		191	39.3
	No	3785	51.6		240	49.4
	Exdrinker	9	0.1		2	0.4
	Unknown	474	6.4		53	10.9
	Total	7341	100.0		486	100.0
	Beer					
	Yes	3237	44.1	<.01	248	51.0
	No	3627	49.4		185	39.9
	Exdrinker	14	0.2		2	0.4
	Unknown	463	6.3		51	10.1
	Total	7341	100.0		486	100.0
	Hard Liquor					
	Yes	3530	48.1		241	49.6
	No	3339	45.5		194	39.9
	Exdrinker	10	0.1		2	0.4
	Unknown	462	6.3		49	10.1
	Total	7341	100.0		486	100.0

TABLE 27. HOME SAFETY DATA SUMMARY--ACCIDENT BACKGROUND--ALCOHOL CONSUMPTION, INJURY.

Accident Factor, Reference, N	Number and % of Admissions with Positive Breathalyzer Levels		
Breathalyzer levels of home accident admissions, (79) Weschler et al, 1967, Emergency Service, Massachusetts General Hospital	Cause of injury	No. of patients	% of the patients with positive levels
	Accidental falls	272	22.8
	Cutting & peircing	140	25.7
	Collisions with persons or objects	63	25.4
	Fires/explosions	33	18.2
	Other	104	10.6
	Nature of injuries		
	Lacerations/abrasions	208	27.4
	Fractures/dis-locations	124	15.3
	Contusions	113	19.5
	Sprains	76	14.5
	Head injuries	53	30.2
	Burns	31	16.1
	Other	8	12.5

TABLE 28. HOME SAFETY DATA SUMMARY--ACCIDENT BACKGROUND--DRUG AVAILABILITY.

Accident Factor, Reference, N	% Control (No injuries) vs Code (Injuries) Households					Remarks
Type of drug availability (68) Tokuhata et al, 1973, household member interviews		Control		Code		Households answering "yes" were more likely to have injuries, except in the anti-depressant/stimulants category
	Type of Drug	N	% P	N	%	
	Antihistamines					
	No	1369	44.8	243	32.3	
	Yes	1685	55.2 <.001	508	67.6	
	Unknown	1	0	1	0.1	
	Total	3055	100.0	752	100.0	
	Tranquilizers Relaxents Sedatives Hypnotics					
	No	2143	70.2	518	68.9	
	Yes	910	29.7 <.02	234	31.1	
	Unknown	2	0.1	--	--	
	Total	3055	100.0	752	100.0	
	Antidepressants/ Stimulants					
	No	3023	99.0	732	97.4	
	Yes	31	1.0	19	2.5	
	Unknown	1	0	1	0.1	
	Total	3055	100.0	752	100.0	
	Diet Pills					
	No	2934	96.1	690	91.7	
	Yes	120	3.9 <.001	62	8.3	
	Unknown	1	0	--	--	
	Total	3055	100.0	752	100.0	
	Hormones					
	No	2521	82.5	588	78.2	
	Yes	533	17.5 <.02	163	21.7	
	Unknown	1	0	1	0.1	
	Total	3055	100.0	752	100.0	

TABLE 29. HOME SAFETY DATA SUMMARY--ACCIDENT BACKGROUND--TYPE MEDICATION ERROR FACTOR.

Accident Factor, Reference N	Number and Frequency of Errors	Remarks

Factors in medication errors

(41) Neely and Patrick, 1964, N=59 Clinic attendees, 60+ years age, Seattle, Washington

Medication Errors	Frequency	Percent
0	24	41
1	10	17
2	11	19
3	8	13
4	6	10
Total Respondents	59	100
Number of Respondents Making Errors	35	
Total Errors	80	

Type of Error	Frequency	Percent
Omission	38	48
Inaccurate knowledge	27	34
Self medication*	12	15
Improper timing and sequence	2	2
Incorrect dosage	1	1
Total Errors	80	100

Potentially Serious Errors		Serious Error Makers **
Type of Error	Frequency	Frequency
Omission	14	11
Inaccurate knowledge	8	7
Self-medication	6	5
Incorrect dosage	0	0
Improper timing, sequence	0	0
Total	28	23

Medication Management Factors	Number of Respondents: No Error	One or More Potentially Serious Errors	Total
Housing			
4 rooms or less	9	3	12
4 rooms or more	15	16	31
x^2 = 2.47 Not d.f.=1, p=.10, Significant			
Number of Prescribed Medications			
1 or 2 medications	17	6	23
3 or more medications	7	13	20
x^2 = 6.68 Not d.f.=1, p=.01, Significant			
Number of Places Where Medications Were Kept			
1 and 2 places	22	13	35
3 or more places	2	6	8
x^2 = 2.49 Not d.f.=1, p=.10, Significant			
Method of Remembering to Take Medications			
Planned	14	5	19
Not planned	10	14	24
x^2 = 3.65 d.f.=1, p=.05, Significant			
Respondents' Perception of Illness			
"Big problem"	7	12	19
"Some problem" and "no problem"	17	7	24
x^2 = 4.95 d.f.=1, p=.05, Significant			

*Taking medication prescribed for a previous illness.

**E.g., 14 errors of omission were made by 11 respondents, i.e. a mean of 1.3 errors per respondent.

TABLE 30. HOME SAFETY DATA SUMMARY--ACCIDENT BACKGROUND--ACCIDENT SITE OF FALLS.

Accident Factor, Reference, N	Number and % of Falls					
Room of fall; (35) Lucht, 1967-68 Denmark; N=472, 60 + yrs. of age		Men		Women		Total	
		N	%	N	%	N	%
	Living Rooms	28	26	131	36	159	34
	Stairs	33	31	72	20	105	22
	Hall	11	10	48	13	59	12
	Bedroom	14	13	38	11	52	11
	Kitchen	3	3	48	13	51	11
	Toilet & Bathroom	12	11	19	5	31	7
	Cellar, Scullery & Washhouse	7	6	8	2	15	3
		108	109	364	100	472	100

TABLE 31. HOME SAFETY DATA SUMMARY--ACCIDENT BACKGROUND--IN-HOME LOCATION.

Accident Factor, Reference, N	Location % of Accidents by Sex		Remarks
Part of house; (42) Neutra and McFarland, California Dept. of Health, 1957; N-NA	Location	%	Data collection procedure unknown
		Male / Female	
	Kitchen	19 / 35	
	Basement	15 / 7	
	Bedroom	10 / 11	
	Living room	8 / 11	
	Bathroom	5 / 4	
	Other inside	10 / 13	
	Yard	16 / 9	
	Other outside	16 / 11	
	Not Stated	1 / 1	

TABLE 32. HOME SAFETY DATA SUMMARY--ACCIDENT BACKGROUND--FIXTURES, FREQUENCY.

Accident Factor, Reference, N	% of Accidents by Fixture		Remarks
Accident frequency, installed fixtures; (16) Design Guide, 1969, N-NA	Fixture	% Accidents	Telephone survey by Teledyne Brown Engineering for HUD.
	Stairs	28.0	
	Tubs and Showers	18.0	
	Glass doors	13.0	
	Windows	12.5	
	Doors other than glass	11.0	
	Electrical outlets	3.0	
	Hot water system (burns)	3.0	
	Kitchen cabinets	2.5	
	Floors (other than concrete)	2.0	
	Light switches	2.0	
	Concrete floors	1.5	
	Range hoods	1.5	
	Garbage disposals	1.0	
	Electrical fixtures (hanging)	1.0	
	Sinks	0.5	
	Electrical wire	0.5	

TABLE 33. HOME SAFETY DATA SUMMARY--ACCIDENT BACKGROUND--FIXTURES, SEVERITY.

Accident Factor, Reference, N	Percent Severity of Injury by Fixture						Remarks
		Major			Minor		
Accident Severity, Installed fixtures,		Death	Perm Disability	Hosp'n	Private Physician	Home Treated	No Treatment
(16) Design Guide, N=NA	Stairs	--	--	8.1	22.4	30.6	32.6	Data not directly related to other data from this reference.
	Glass doors	--	--	4.2	19.1	42.6	19.1	
	Tubs & Showers	1.4	1.4	--	2.9	43.5	37.7	
	Windows	--	2.2	2.2	8.0	46.7	24.4	
	Floors-non concrete	--	16.7	--	66.6	--	16.7	
	Garbage disposal	--	--	--	66.7	--	33.3	
	Electrical fixtures-hanging	--	--	--	50.0	--	50.0	
	Doors-non glass	--	--	--	27.8	44.4	22.2	
	Concrete floors	--	--	--	25.0	25.0	50.0	
	Kitchen cabinets	--	--	--	14.3	14.3	42.8	
	Hot water system (burns)	--	--	--	9.1	45.4	36.4	
	Electrical outlets	--	--	--	7.7	30.7	53.9	
	Sinks	--	--	--	--	100.0	--	
	Rangehoods	--	--	--	--	25.0	75.0	
	Electrical wire	--	--	--	--	--	100.0	
	Light Switches	--	--	--	--	--	71.4	

TABLE 34. HOME SAFETY DATA SUMMARY--ACCIDENT BACKGROUND--FLOOR SURFACE EFFECT IN FALLS.

Accident Factor, Reference, N	Frequency of Defects Involved							
Floor surface in rooms; (35) Lucht, 1967-68, Denmark, N = 18 male and female	Defects	Living Room	Stairs	Hall	Bed-room	Kitchen	Toilet bath-room	Cellar scullery wash house
	Slippery surface	12	23	10	4	9	7	2
	Loose rug	12	0	10	5	3	0	0
	Loose object	9	3	3	3	3	0	5
	Poor lighting	4	11	1	5	0	0	1
	Doorstep	7	0	5	3	0	2	0
	Defect in fixed carpets	1	6	0	0	0	0	0
	Defect household effects	3	0	3	0	0	0	0
	Others	0	3	1	1	1	3	0
	Total	48	46	33	21	16	12	8 184

TABLE 35. HOME SAFETY DATA SUMMARY--ACCIDENT BACKGROUND--PROCESSES OF FALLS.

Accident Factor, Reference, N	Mean and % of Falls					
Home falls from various levels; (35) Lucht, 1967-68, Denmark; N = 472, 60 + yrs. age		Men		Women		Total	
		N	%	N	%	N	%
	Fall on same level	54	50	229	63	283	60
	Fall down the stairs	33		72		105	
	Fall from chair, stool stepladder or table	13		48		61	
	Fall from bed	4	50	9	37	13	40
	Fall through trapdoor	2		4		6	
	Fall, no information available	2		2		4	
	Total	100	100	364	100	472	100

TABLE 36. HOME SAFETY DATA SUMMARY--ACCIDENT BACKGROUND--IMMEDIATE CAUSES OF FALLS.

Accident Factor, Reference, N	Number of Falls		Remarks
Causes in home and in victim; (35) Lucht, 1967-68, Denmark; N = 396, 60 + yrs age	Domestic causes (184 patients)	N	
	Slippery surface	67	
	Loose rug	30	
	Loose object	26	
	Poor lighting	22	
	Doorstep	17	
	Defect in fixed carpets	7	
	Defect household effects	6	
	Others	9	
	Total Causes	184	
	Causes in the patient (212 patients		
	Dizziness, sudden malaise or weakness	90	
	Difficulty in walking	57	
	Confusion or senile dementia	37	
	Poor sight	18	
	Alcohol consumption	15	
	Chronic disease	10	
	Fainting	7	
	Drug consumption	3	
	Total Causes	235	

TABLE 37. HOME SAFETY DATA SUMMARY- ACCIDENT BACKGROUND--FIRE MORTALITY.

Accident Factor, Reference, N	Mortality Rates									Remarks
	Average Annual Death Rate per 100,000									
		Total Persons			White			Nonwhite		
		Total	Males	Females	Total	Males	Females	Total	Males	Females
Annual death rates per 100,000 population from fires (39) Mortality Rates, Division of Vital Statistics, National Center for Health Statistics 1968-69	All Ages	3.6	4.4	2.9	2.9	3.6	2.3	8.5	10.1	6.9
	Under 1	5.4	5.4	5.4	3.2	3.0	3.3	15.6	16.5	14.8
	1-4	5.8	6.3	5.4	3.8	4.2	3.4	15.7	16.3	15.1
	5-9	2.3	2.3	2.3	1.7	1.7	1.6	5.7	5.5	5.9
	10-14	1.0	1.1	0.8	0.8	0.9	0.7	2.0	2.2	1.9
	15-19	0.9	1.0	0.7	0.7	0.9	0.6	1.9	2.2	1.6
	20-24	1.3	1.9	0.8	1.1	1.6	0.7	2.7	3.9	1.6
	25-34	1.8	2.5	1.1	1.5	2.0	0.9	4.2	6.3	2.3
	35-44	2.7	3.7	1.8	2.3	3.0	1.5	6.5	9.5	4.0
	45-54	3.9	5.2	2.7	3.4	4.4	2.5	8.4	12.5	4.8
	55-64	5.8	7.8	4.0	5.0	6.6	3.6	13.5	19.3	8.4
	65-74	8.0	10.3	6.1	6.2	8.1	4.7	29.3	35.6	23.9
	75 and over	16.0	20.6	13.0	13.5	18.0	10.4	45.0	46.8	43.7

All deaths from conflagration or ignition burning except in transportation, regardless of nature of injury. These data may not reflect the order of magnitude by age groups for residential fires only.

TABLE 38. HOME SAFETY DATA SUMMARY--ACCIDENT BACKGROUND--BURN HAZARDS.

Accident Factor, Reference, N	Number and % Hospitalized Burn Cases						Remarks
Source of burns, (40) National Safety Council, 1977; New York 1974, Cases	Hazard	Total N	Total %	Fatal N	Fatal %	Nonfatal N	Nonfatal %	10 most frequent hazar
	All Cases	2,862	100.0	102	100.0	2,760	100.0	
	Hot water	488	17.1	8	7.8	480	17.4	
	Clothing	321	11.2	36	35.3	285	10.3	
	Hot beverages	290	10.1	3	2.9	287	10.4	
	Gasoline	205	7.2	5	4.9	200	7.2	
	Chemicals	170	6.0	5	4.9	165	6.0	
	Cooking grease	167	5.8	1	1.0	166	6.0	
	Ranges, ovens	83	2.9	0	0.0	83	3.0	
	Conflagrations	81	2.8	12	11.8	69	2.5	
	Wires, cords	61	2.1	1	1.0	60	2.2	
	Automotive	61	2.1	0	0.0	61	2.2	
	Other, unspecified	935	32.7	31	30.4	904	32.8	

TABLE 39. HOME SAFETY DATA SUMMARY--ACCIDENT BACKGROUND--PRE-EXISTENT FACTORS IN BURNS.

Accident Factor, Reference, N	Number and % Hospitalized Burn Cases					
Reported pre-existent factors in burn cases; (40) National Safety Council, 1977; New York, 1974, cases.		Both Sexes		Male		Female
	Factor	N	%	N	%	N	%
	Factors Reported	1,140	100.0	643	100.0	497	100.0
	Cardio-vascular disease	173	15.2	95	14.8	78	15.7
	Alcohol	140	12.3	106	16.5	34	6.9
	Obesity	109	9.6	47	7.3	62	12.5
	Diabetes	89	7.8	46	7.2	43	8.7
	Mental disability	64	5.6	36	5.6	28	5.6
	Physical disability	49	4.3	32	5.0	17	3.4
	Child abuse	48	4.2	24	3.7	24	4.8
	Senility	37	3.2	17	2.6	20	4.0
	Epilepsy	27	2.4	12	1.9	15	3.0
	Retardation	21	1.8	13	2.0	8	1.6
	Stroke	16	1.4	11	1.7	5	1.0
	Other, unspecified	367	32.2	204	31.7	163	32.8

TABLE 40. HOME SAFETY DESIGN RECOMMENDATIONS SUMMARY--CHECK LISTS

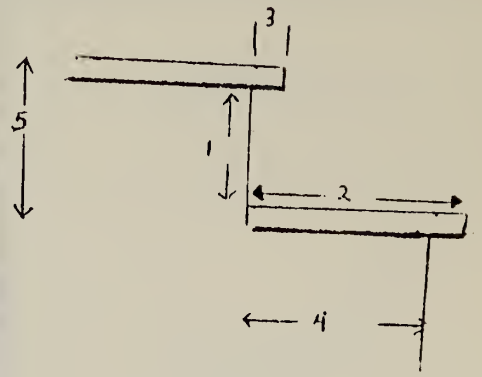
Type of Recommendations	Recommendations Data		Remarks
Checklists for items as noted, (16) Design Guide, Normal People	Stairs & Ramps		
	Interior Stairs	Riser height 19.05 cm maximum Run width 25.40 cm maximum Tread width 28.57 cm maximum Nosing 3.17 cm maximum	
	Exterior Stairs -attached	Riser height 15.24 cm maximum Run width 27.94 cm maximum Tread width 30.48 cm maximum Nosing 2.54 cm maximum	
	Exterior Stairs -unattached	Riser height 12.70 cm maximum Run width 35.56 cm maximum Tread width 38.10 cm maximum Nosing 2.54 cm maximum	1. Riser 2. Tread 3. Nosing 4. Run 5. Rise
	All Stairs	Maximum variation in risers and tread within one flight - 0.32 cm.	
	Interior Ramps	Slope 7°* to 15°	*Wheelchair ramps should not exceed 8.33% gradient.
	Handrails & Railings	Handrails on all flights with more than three risers. Continuous railings in open sides of stairs, handrails on wall side. Height of handrails above nosing, 76.20 to 86.36 cm. Handrail grip size, minimum horizontal dimension - 6.67 cm.	

TABLE 40. HOME SAFETY DESIGN RECOMMENDATIONS SUMMARY--CHECK LISTS (CONTINUED).

Type of Recommendations	Recommendations Data		Remarks
		Railing apertures small enough to not pass a sphere >12.70 cm in diameter Handrail height, floor to top: - Decorative and room dividers--76.20 cm minimum - Balconies and stairwells--106.68 cm minimum - Porches and platforms--76.20 cm minimum Headroom clearance continuous above nosing at 223.52 cm Minimum stairwidth inside newel post and/or hand rails - 101.60 cm	
	Windows		
	Window walls	Sill height above floor 30.48 cm minimum. Use of safety glazing Use of protective barriers in front of window wall	
	Low window sills	Sill height above floor - 91.44 cm minimum Use of safety glazing Use of protective barriers on front of sills.	

TABLE 40. HOME SAFETY DESIGN RECOMMENDATIONS SUMMARY--CHECK LISTS (CONTINUED).

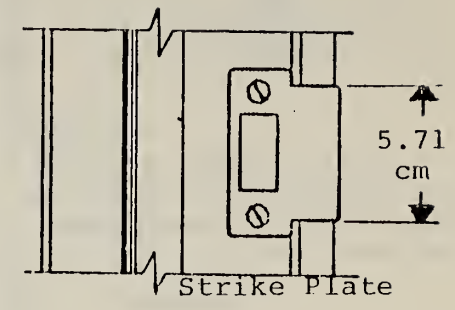
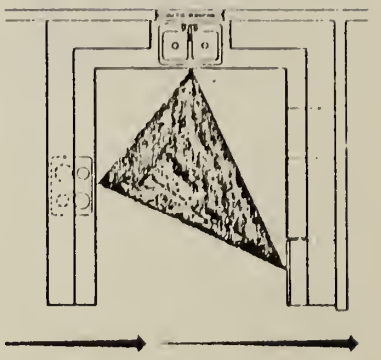
Type of Recommendations	Recommendations Data		Remarks
	Doors	Use safety glazing	
	Glass doors	Use conspicuous marking features at adult and children age level	
	Door swing	Avoid double acting swinging doors Hinged doors swing open a minimum of 90° Hinged doors swing into room, preferably against a wall when fully open Landing provided where door must swing into stairs.	
	Door frames and hardware	Edges and corners rounded Strike plates should have rounded corners, a lip of 5.71 cm minimum vertical dimension, and be bent back flush with door.	
		Hydraulic or controlled rate of closure door closing mechanisms	
		Avoid rigid door stops	
		Avoid glass, ceramic or plastic knobs	
		Position door knobs 6.98 cm from door edge	
		Clothes hooks on door above eye height	

TABLE 40. HOME SAFETY DESIGN RECOMMENDATIONS SUMMARY--CHECK LISTS (CONTINUED).

Type of Recommendations	Recommendations Data		Remarks
		Closet doors with non-locking latches and operable from inside closet.	These data do not include details of appliance integration into kitchen design.
	Kitchen-General		
	Work triangle	Sum of sides of work triangle no greater than 689.50 cm Traffic flow avoids work triangle Minimum spacing of 121.92 cm between fixtures	
	Cabinet layout*	Top shelves no higher than 182.88 cm above floor Counter tops 91.44 ± 0.635 cm above floor Maximum width of counter tops 60.96 cm under wall cabinets and 76.20 cm without wall cabinets.	
	Bathroom		
	Tubs and showers	Nearly flat bottom bathtub. Slip resistant bathtub and shower Bathtub/shower controls 81.28 ± 5.08 cm above inside bottom surface Bathtub (only) controls 86.36 cm maximum above inside botton surface Shower (only) controls 127.00 ± 5.08 cm above inside botton surface Safety glazing for bathtub and shower enclosures No locking latches used on bathtub and shower doors Soap dish 81.28 ± 5.08 cm above inside bottom surface of tub/shower combination	



Example of a well planned kitchen which provides ample working space, an adequately proportioned work triangle, and a through traffic plan which does not interfere with kitchen activities.

*Dimensions are for "normal" people and may not be appropriate for some disabled.

TABLE 40. HOME SAFETY DESIGN RECOMMENDATIONS SUMMARY--CHECK LISTS (CONTINUED).

Type of Recommendations	Recommendations Data		Remarks
		Towel bar or ring within 15.24 cm of tub/shower combination or shower stall	
		Two grab bars in each tub One grab bar in shower stall Grab bars securely installed Grab bars free of impact or pinch hazards Grab bars of durable material All devices and accessories which can be used as a grab bar meet grab bar criteria	
	Water supply and controls	Hot to left, cold to right at all faucet sets. Faucets clearly marked with motion pattern and results Hot water for body use automatically temperature limited to 46.10°C maximum	
	Fixtures and spacing-General	Countertop, vanity or space at least 91.44 cm for each lavoratory	
		60.96 cm deep pace floor space in front of each lavatory	
		91.44 cm wide space if toilet between two walls 71.12 cm wide space if toilet between tub and lavatory or vanity 81.28 inch wide space if toilet between wall and another fixture	

TABLE 40. HOME SAFETY DESIGN RECOMMENDATIONS SUMMARY--CHECK LISTS (CONTINUED).

Type of Recommendations	Recommendations Data	Remarks
	Clearance of 50.80 cm minimum in front of toilet Free floor space at least 76.20 cm deep in front of tub or shower stall Free activity space at least 76.20 cm x 106.68 cm	

TABLE 41. HOME SAFETY DESIGN RECOMMENDATIONS--KITCHEN ILLUMINATION.

Type of Recommendation	Recommended Light Levels	
		Footcandles
Illumination Recommendation - Kitchen	Kitchen sinks	70
	Range cooking surface	50
	Kitchen counters	50
	Ironing boards and machines	50
	Kitchen desks	30
	Laundry trays	50
	Washing machines	30
	General lighting	30

Ref. (16): Design Guide, IES Illumination Standards

TABLE 42. HOME SAFETY, DESIGN RECOMMENDATIONS SUMMARY--AREA ILLUMINATION.

Type of Recommendation	Recommended Illumination			
Illumination recommendation -- General	Range	footcandles	(dekalux)	Type of Activity
	A			
	General lighting for areas used infrequently or having simple visual demands	2	(2)	-Public areas with dark surroundings
		3	(3)	
		5	(5)	
		8	(8)	-Simple orientation for short temporary visits only
		11	(10)	
		16	(15)	-Rooms not used continuously for working purposes, e.g., storage areas, entrance halls
		21	(20)	-Tasks with limited visual requirements, e.g., rough machining, lecture theaters
	B			
	General lighting for working interiors	32	(30)	
		54	(50)	
		81	(75)	-Tasks with normal visual requirements, medium maching, offices
		106	(100)	
		160	(150)	-Tasks with special visual requirements, e.g., hand engraving, clothing factory inspection
		210	(200)	
	C			-Very prolonged and exacting visual tasks, e.g., minute electronic and watch assembly
	Additional lighting for visually exacting tasks	320	(300)	
		540	(500)	
		810	(750)	-Exceptionally exacting visual tasks, e.g. microelectronic assembly
		1080	(1000)	
		1600	(1500)	-Very special visual tasks, e.g., surgical operations
		2100	(2000)	

Reference (7): Bennet. Unofficial illumination standards.

DISABILITY

TABLE 43. DISABILITY DATA SUMMARY--GENERAL.

Disability	Distribution of U.S. Risk Population by Subgroups, About 1970 and 1975

General Risk population

Subgroup	Estimated Population (000)		Number per 1,000 Population
	About 1970	About 1975	
1. Preschool children (under 6)	20,965[a]	20,926	91.50
2. School-age children (6-17)	48,679[a]	46,482	216.57
3. Persons over 65	20,065[a]	22,170	103.30
4. Confined to wheelchair	409[b]	445	2.07
5. Walk with special aids	4,638[b]	5,042	23.49
6. Walking with difficulty	2,156[b]	2,344	10.92
7. Chronic impairment of upper extremities and shoulders	2,440[c]	2,588	12.06
8. Severe auditory impairment.	1,592[d]	1,867	8.70
9. Severe visual impairment	475[e]	482	2.25
10. Obvious confusion and/or disorientation	20,000[f]	20,000	93.19

[a]See U.S. Bureau of the Census, *U.S. Summary: General Population Characteristics*, Vol. 1, Pt. 1, Tables 50, 52 and 53, Washington, D.C., 1970.

[b]See DHEW, *Vital and Health Statistics*, Series 10, No. 78, Washington, D.C., 1969.

[c]See DHEW, Series 10, No. 87, 1971.

[d]See DHEW, Series 10, No. 35, 1964.

[e]See DHEW, Series 10, No. 46, 1963-64; and Hatfield, E. M. "Estimates of Blindness in the United States." *The Sight-Saving Review*, vol. 43, no. 2, 1973, pp. 69-80. Also see unpublished report of the National Society for the Prevention of Blindness, Inc., January, 1975.

[f]Partial reference list includes (1) Mudlord, H. A., "Drinking and Deviant Drinking, U.S.A., 1963," *Quarterly Journal of Studies on Alcohol*, vol. 25, 1964; (2) Eddy, Nathan, H. Halbach, I. H. Isbel, and M. E. Seevers, "Drug Dependence: Its Significance and Characteristics," Bulletin *WHO*, vol. 32, 1965; and (3) Martindale, D., and E. Martindale, *The Social Dimension of Mental Illness, Alcoholism and Drug Dependence* (Glenwood Publishing Co., 1973).

Reference: (5) Bednar, 1977

TABLE 44. DISABLED DATA SUMMARY--GENERAL MOTOR.

Disability	Disability-Effect Matrix

Effects of disabilities

	impairment of mental faculties	incontinence	day-to-day condition unpredictable	communication difficulties	impairment of vision	bodily deformity	pain	progressive deterioration	sensory impairment	lack of coordination	impairment of sex functions
poliomyelitis	○	○	○	○	○	◔	○	○	○	○	○
lower limb amputation	○	○	○	○	○	◔	◔	○	◔	○	○
brittle bones	○	○	○	○	○	◑	◔	○	○	○	○
muscular dystrophy	○	○	○	○	○	◕	○	◕	○	○	○
motor neurone disease	○	◔	○	○	○	◑	○	●	○	○	○
syringomyelia	○	○	○	○	○	◑	○	◕	◑	○	○
osteoarthritis	○	○	◔	○	○	◔	◑	◑	○	○	◔
Parkinson's disease	○	○	○	◑	○	◔	○	◑	◔	◔	◔
Friedrich's ataxia	○	○	○	◔	○	◔	○	●	○	●	○
paraplegia and tetraplegia	○	●	○	○	○	○	◔	○	●	○	◑
hemiplegia	◑	◔	○	◑	◔	◑	◔	◔	◑	◔	◔
rheumatoid arthritis	○	○	◕	○	○	●	●	◕	○	○	◔
spina bifida	◕	●	○	○	○	◔	○	○	●	○	◑
cerebral palsy	◕	◔	○	●	○	◕	○	○	◑	◑	◔
multiple sclerosis	◕	●	●	◔	◑	◑	○	●	◔	◕	◑

The values signified by the circles are as follows

○ No directly associated effects

◔ Directly associated effects in some cases, or slight associated effects in general.

◑ Commonly associated effects, particularly prevalent where the disability is severe.

◕ Associated effects in the majority of cases, general where the disability is severe.

● Associated effects in all cases, with exceptions only where the disability is minimal.

Reference: (23) Goldsmith, Reprinted from Designing for the Disabled by Selwyn Goldsmith with the kind permission of RIBA Publications Ltd.

TABLE 45. DISABILITY DATA SUMMARY--DEAFNESS, PREVALENCE.

Disability	Source of Data	Type of Data
Deafness -prevalence of hearing events	Examination and medical history of 7,119 children, 6-11 yrs. age 1963-1965	Rate per 100 children of hearing events associated with deafness for age and sex

Reference: (27) National Health Survey 1963-65, 7, 119 children

Data

	Trouble hearing	Earaches	Injury to ear	Drum perforated	Other ear operation	Running ears	Other ear trouble
	Rate for 100 Children						
Boys							
Total, 6-11 years	4.7	24.7	2.4	3.3	•	12.1	5.0
6 years	5.0	28.0	1.0	4.2	•	13.1	6.6
7 years	5.2	30.0	3.4	3.4	•	14.9	3.1
8 years	4.4	26.4	2.5	3.0	•	13.2	5.7
9 years	5.0	23.8	2.5	3.2	•	11.0	4.7
10 years	4.2	20.7	1.5	3.3	•	10.7	5.5
11 years	4.3	18.4	3.4	2.3	•	9.3	4.4
Girls							
Total, 6-11 years	3.7	28.6	2.4	2.7	•	11.6	4.6
6 years	2.2	28.4	1.2	3.1	•	11.4	4.7
7 years	3.8	31.1	2.0	2.5	•	14.4	6.3
8 years	2.0	24.1	1.8	2.5	•	9.0	4.6
9 years	4.4	27.4	3.3	2.4	•	12.0	4.4
10 years	4.7	31.7	3.4	3.0	•	14.1	4.0
11 years	5.1	29.3	2.8	2.6	•	8.3	3.7
Both sexes							
Total, 6-11 years	4.2	26.6	2.4	3.0	0.7	11.8	4.8
6 years	3.6	28.2	1.1	3.6	•	12.2	5.6
7 years	4.5	30.6	2.7	3.0	•	14.6	4.7
8 years	3.2	25.2	2.2	2.8	•	11.1	5.2
9 years	4.7	25.6	2.9	2.8	•	11.5	4.6
10 years	4.4	26.2	2.4	3.2	•	12.4	4.8
11 years	4.7	23.8	3.1	2.4	•	8.8	4.0

TABLE 46. DISABILITY DATA SUMMARY--DEAFNESS, LEVEL.

Disability	Source of Data	Type of Data	Data	Remarks
Deafness--hearing level	Ibid	Hearing level* in decibles by age and sex	See table below	*Average in better ear at each test frequency (CPS)

Averages in decibels re audiometric zero (ASA 1951)

	250 cps		500 cps		1000 cps		2000 cps		3000 cps		4000 cps		6000 cps		8000 cps	
	Hearing trouble	None	Hearing trouble	None	Hearing trouble	None	Hearing trouble	None	Hearing trouble	None	Hearing trouble	None	Hearing trouble	None	Hearing trouble	None
Boys																
Total, 6-11 years	69	98	51	90	26	78	43	91	03	50	42	21	42	20	07	60
6 years	-60	77	48	72	41	64	61	80	04	42	13	12	38	21	-21	38
7 years	63	87	43	-76	-15	68	64	86	12	42	21	13	17	22	17	58
8 years	-70	99	-27	87	17	73	41	92	12	50	37	22	23	30	17	61
9 years	-76	-106	64	97	28	86	25	96	02	55	57	26	69	31	26	-72
10 years	64	114	53	104	-10	89	40	-98	18	56	56	26	63	29	60	70
11 years	-75	-118	76	107	41	91	17	96	34	55	74	29	52	24	08	86
Girls																
Total, 6-11 years	61	93	48	93	30	82	87	95	-18	56	17	24	34	31	03	67
6 years	-47	73	38	75	39	70	78	88	50	54	07	15	19	24	20	55
7 years	02	82	14	81	32	-76	56	90	21	-50	50	20	58	27	46	80
8 years	38	100	65	99	49	61	102	96	29	58	17	20	13	41	28	76
9 years	48	93	41	82	11	80	60	97	17	52	36	22	42	29	11	68
10 years	77	106	72	109	73	04	80	102	47	62	33	35	16	36	25	71
11 years	78	108	58	104	33	88	49	102	01	62	40	32	41	31	09	75
Both sexes																
Total, 6-11 years	61	96	50	91	28	80	51	93	06	53	31	23	19	29	06	64
6 years	54	74	41	73	38	67	64	83	15	47	13	13	33	22	04	46
7 years	37	84	27	78	05	72	57	88	11	46	38	16	39	24	14	69
8 years	56	99	33	92	24	76	57	94	15	54	24	21	23	35	17	68
9 years	60	99	51	94	18	83	19	96	11	53	50	24	59	10	22	70
10 years	69	110	62	106	42	91	59	99	15	60	12	31	19	12	17	70
11 years	75	111	64	106	37	93	17	98	18	58	59	30	49	22	01	69

Reference: (27) National Health Survey, 1963-65, 7,119 Children

TABLE 47. DISABILITY DATA SUMMARY- OTHER.

Disability	Source of Data	Type of Data	Data	References	Remarks
Paraplegia	Nat'l Paraplegia Foundation	Prevalence, numbers Incidence, numbers Ages at onset Ratio of men to women Causes of SCI	Prevalence - 175,000/220,000,000 Incidence - 6,500/220,000,000 Ages: 0-10 2.7% 10-19 18.9 20-29 31.2 30-39 11.5 40-49 10.8 50-59 11.1 60-69 7.3 70-79 6.5 Ratio of men to women - 2.82 to 1 Causes: Road Traffic 55.9% Falls 19.2 Sport 6.9 Assault 12.0 Other 6.0	Letter: National Paraplegia Foundation 369 Elliot Street Newton Upper Falls, Massachusetts 02164 Telephone contact, 6-01-78 sent literature	For further stats refer to: National Spinal Cord Injury Data Research Center 1013 E McDowell Rd Phoenix, AZ 85006
Myasthenia Gravis	Myasthenia Gravis Foundation, Inc.	Pamphlet HELP IS ON THE WAY - Handbook for patients WHAT IS MYASTHENIA GRAVIS? WHO AM I? CONQUEST - NEWSLETTER MYASTHENIA GRAVIS (Hope thru research)	What is Myasthenia Gravis? Serious muscle weakness. How long has it been known? As early as 1672. How common is it? Exact incidence is not known/estimated to be 1 in 10,000 to 40,000 of the general population. In whom & at what age does it begin? Occurs in all races and both sexes at any age but is more frequent in women than men. Begins in women more often between the ages of 20 and 40 and in men after the age of 40. Is it inherited? It is not directly inherited, and occurence among two members of the same family is uncommon though greater than chance alone explains. Is it communicable? No. What are the symptoms of it? May be any of the following alone or in combo: dropping of one or both eyelids, blurred vision, double vision, loss of facial expression, difficulty in chewing or swallowing, an easily fatigued slurred voice, difficulty in breathing, difficulty in raising the arms overhead, weakness in the arms and hands, difficulty	Literature: Myasthenia Gravis Foundation, Inc. National Office 230 Park Avenue New York, NY 10017 Telephone contact, 5-26-78	

TABLE 47. DISABILITY DATA SUMMARY--OTHER (CONTINUED)

Disability	Source of Data	Type of Data	Data	References	Remarks
			in extending the fingers, weakness in flexing the thighs at the hips, weakness in the lower limbs especially when trying to walk on the heels. What may make symptoms worse? Weakness is usually increased by physical activity, emotional upsets, loss of sleep, menstruation and especially such respiratory infections as the common cold. What are the possible causes? Do not know the exact cause of it, however, we have evidence that there is a defect in the transmission of the nerve impulse to the muscle. Are there tests to aid diagnosis? Your doctor may give two tests aiding in the diagnosis of myasthenia gravis. What drugs may help? Pyridostigmine is probably the most popular and widely used at present, but there are others. How much drug should be taken and what results expected? The doctor tailors the dosage to each individual patient. Overdosage with these drugs may cause weakness similar to that when insufficient drug is given. Are there other effects of these drugs? Patients may experience nausea, diarrhea, abdominal cramps, vomiting, urgent or frequent urination and bronchial asthma as well as increased salivation. How may the needed expensive drugs be bought for less? Many myasthenia gravis chapters and clinics across the country sponsor drug banks. Patients may buy the drugs at reduced prices in standard quantity lots.		
			At least 240,000 men, women and children are M.G. victims. Many thousands more still remain undiagnosed.		

TABLE 47. DISABILITY DATA SUMMARY - OTHER (CONTINUED)

Disability	Source of Data	Type of Data	Data	References	Remarks
Epilepsy	Epilepsy Foundation of America	Prevalence, #'s Incidence, #'s Age of onset Causes Role of heredity Treatment 3 major problem areas	Prevalence - 2,135,000 (1,409,000 who have sought medical or social services, plus an estimated 725,900 undetected cases) Incidence - 100,000 cases per year Age of onset - 30% of cases develop before age 5; 75% develop before age 18 Causes - Brain injury during pregnancy and delivery injury, infection, or systemic illness of the mother may be the cause. Poisoning, such as lead poisoning. More than 5,000 are hospitalized each year for seizures related to alcoholism. More than 25% of acuiqred ("organic") epilepsy results from infection - lupus erythematosus, meningitis, viral encephalitis, and less frequently, mumps, measles, diptheria and others. Head trauma of any type, especially from accidents on the highway, in sports, and falls and blows at work or in the home. Alteration in blood sugar, vitamin deficiencies, dehydration, or changes in the balance of such mineral as calcium, potassium and manganese. Brain tumor and stroke. Role of heredity: Inheritance plays a very minor role. Treatment: Medical treatment can achieve full control of seizures in about 50% of cases, and various degrees of control in about 30% of cases. Remainder are unaffected by treatment. Major form of treatment is drug therapy, brain surgery used only for certain types of epilepsy, dietary control, 75% of cases can be treated within the local community. The more severely affected, some 25%, need special services and care. Medical control despite current treatment methods, people with epilepsy are estimated to have a total of 12,000,000 seizures a year. Sodium valproate and other existing drugs and services could eliminate	Epilepsy Foundation of America Suite 406 1828 L Street, NW Washington, D.C. 20036 Telephone contact, 5-23-76: sent literature	Local organization nearest us: Washington, D.C. Area Chapter, 815 - 15th St. Suite 706 Washington, D.C. 20005

TABLE 47. DISABILITY DATA SUMMARY--OTHER (CONTINUED)

Disability	Source of Data	Type of Data	Data	References	Remarks
			1,000,000 of these seizures if they were made available and properly utilized to treat this condition. Unemployment/underemployment 20%-30% of those physically able to work are unemployed. The problem is aggravated by the fact that among those who are working, many are in jobs well below their levels of education and ability. Public awareness--for a majority of persons with epilepsy, public attitudes create a greater disability than the medical condition itself.		
Hemophilia	National Hemophilia Foundation	Prevalence Mean Frequency of Episodes Age distribution	Prevalence Rate: Hemophilia A: 1 in 10,000 males Severe 55% Moderate 25% Mild 20% Hemophilia B: 1 in 40,000 males Severe 25% Moderate 28% Mild 47%	Telephone contact, 6-02-78	
			Mean Frequency of Episodes: Severe 40/yr (Hemophilia A) Severe 40/yr (Hemophilia B) Moderate 15/yr (Hemophilia A) Moderate 15/yr (Hemophilia B) Mild 2/yr (Hemophilia A) Mild 2/yr (Hemophilia B)	"	Additonal info available thru the Nat'l Hemophilia Foundation new Nat'l Hemophilia Registry Program but the first data from the project will likely not be available for a year.
		Doses Schedules	For each bleeding episode 15 units of AHF per kilogram of body weight for Hemophilia A patients 20 units of PTC per kilogram of body weight for Hemophilia B patients		

TABLE 47. DISABILITY DATA SUMMARY--OTHER (CONTINUED)

Disability	Source of Data	Type of Data	Data	References	Remarks
		Age Distribution	Age: Younger than 1; Mean Body Weight (lbs): 14; Est. Age Distribution of the Hemophilic Pop. 1976: 1.3; 1980: 1.5 Age: 1-4; Mean Body Weight (lbs): 40; 1976: 6.6; 1980: 5.8 Age: 5-14; Mean Body Weight (lbs): 66; 1976: 27.8; 1980: 22.5 Age: 15-24; Mean Body Weight (lbs): 142; 1976: 31.1; 1980: 27.9 Age: 25-34; Mean Body Weight (lbs): 165; 1976: 15.2; 1980: 19.4 Age: 35-44; Mean Body Weight (lbs): 169; 1976: 9.9; 1980: 11.8 Age: 45-54; Mean Body Weight (lbs): 168; 1976: 4.6; 1980: 6.3 Age: 55-64; Mean Body Weight (lbs): 155; 1976: 2.0; 1980: 2.9 Age: Older than 64; Mean Body Weight (lbs): 157; 1976: 1.3; 1980: 1.9	Nat'l Heart Lung & Blood Inst., Div. of Blood Diseases & Resources, Bethesda, Maryland Nat'l Hemophilia Foundation 25 W 39th St. New York, NY 10018	
Cerebral Palsy	United Cerebral Palsy Assoc.,Inc.	Annual Report Newsletter Pamphlet: Project Prevention	Estimated that some 700,000 children and adults in the U.S., or about 16 out of every 5,000 people manifest one or more of the symptoms of cerebral palsy. Approximately 10,000 infants are born with the condition each year and some 2,000 young children acquire cerebral palsy as a result of head injuries.	United Cerebral Palsy Associations, Inc. 66 E 24th Street New York, NY 10016 Telephone contact, 6-02-78	
Parkinson's Disease	Nat'l Parkinson Disease Foundation, Inc.	Booklets Newsletter	No statistics - General information about Parkinson's disease.	Telephone contact, 6-02-78 sent literature	
Dyslexia	Orton Society, Inc.	Booklet Publications Order Form	Booklet gives no statistics, only tells the facts about the Orton Society - what it is and what it strives to do.	The Orton Society Inc. 8415 Bellona Lane Towson, MD 21204 Telephone contact, 6-01-78	sent literature

TABLE 47. DISABILITY DATA SUMMARY--OTHER (CONTINUED)

Disability	Source of Data	Type of Data	Data	References	Remarks
Blindness	American Foundation for the Blind, Inc. gave me figures that they obtained from Nat'l Center for Health	Statistics Legal Definitions of Blind	A. Severe Visual Impairment - The inability to read ordinary newsprints with glasses B. Legally Blind - If his central visual acurity does not accede 20/200 in the better eye with correcting lenses or his visual field is less than an angle of 20%. Severe Visual Impairment - 1.3 million people Under 45 120,000 45-64 276,000 Over 65 909,000 Legally Blind - 467,000 Figures based on three states (NA, NC, VT) as a projection of the whole United States. Rate per 100,000 Under 5 10.6 5-19 56.6 20-44 106.8 45-64 230.6 65-74 575.0 75-84 1284.5 Over 85 3460.7	American Foundation for the Blind, Inc. 15 W. 16th Street New York, NY 10011 Telephone contact, 5-23-78	
Multiple Sclerosis	Nat'l Multiple Sclerosis Society	Statistics	500,000 MS & Associated Diseases or 250,000 MS Most commonly diagnosis for ages 20-40	Nat'l Multiple Sclerosis Society 205 E. 42nd Street New York, NY 10017 Telephone contact, 6-02-78	
Muscular Dystrophy	Muscular Dystrophy Association, Inc.	Statistics	Estimated 200,000 men, women, and children affected.	Muscular Dystrophy Assoc., Inc. 810 Seventh Ave. New York, NY 10019 Telephone contact, 5-26-78	
Deafness	Nat'l Assoc. of the Deaf	Statistics	1971 Census - Approximately 13,362,842	Nat'l Assoc. of the Deaf, Telephone contact, 6-01-78	To get more stats ordered book entitled Deaf Population of US

TABLE 48. HOUSEHOLD ACTIVITY DATA SUMMARY - ACTIVITY TIME--HOUSEWIVES TIME.

Activity	Minutes per Day	Remarks
General Housework	See detailed table below	A dash (-) indicates < .5 min Note: Reference contains a list of activities and codes for the basic study but not a glossary of terms.

	Employed Men				Employed Women				Housewives			
	M-F	Sat	Sun	Total	M-F	Sat	Sun	Total	M-F	Sat	Sun	Total
Basic Housework												
Cooking	8	6	15	6	44	56	66	49	87	82	89	84
Home chores												
Meal cleanup	3	3	6	3	22	32	28	24	47	40	37	44
Clean house	2	4	8	3	34	63	49	41	61	69	33	73
Outdoor chores	2	4	11	4	1	1	2	1	4	10	1	4
Laundry												
Laundry, ironing	1	1	5	1	22	38	35	20	67	49	10	56
Clothes upkeep	–	1	0	–	2	0	2	2	5	5	1	5
Marketing	9	18	12	11	13	25	6	13	22	17	6	19
Total Hours per Week	1.9 + .6	+ 1.0	= 3.5		11.4 + 3.6	+ 3.1	= 18.1		26.9 + 4.5	+ 2.9	= 34.2	
Other Housework												
Garden, animal care	2	1	2	2	2	3	4	3	6	4	3	5
Errands, shopping												
Shopping	1	4	–	1	1	2	0	1	1	0	0	1
Admin. service	1	–	–	–	1	–	0	1	1	1	0	1
Repair service	1	6	2	2	3	6	1	3	2	–	–	2
Waiting in line	1	6	0	2	1	2	0	1	1	1	0	1
Other service	8	17	7	9	16	19	3	14	18	27	2	17
Other house												
Other upkeep	6	12	17	9	–	1	0	–	4	14	4	5
Heat, water	–	2	2	1	–	–	0	–	–	0	0	–
Other duties	5	11	7	6	10	28	18	13	18	17	21	19
Care to adults	–	12	6	3	7	6	6	7	8	7	11	9
Total Hours per Week	3.3 + 1.2	+ .7	= 4.2		3.4 + 1.1	+ .5	= 5.0		5.0 + 1.2	+ .7	= 6.9	
Grand Total of Hours per Week				7.7				23.1				41.1

Reference: (49) Robinson, 1956, Midwestern householders
N = generally 2000 male and female

TABLE 49. HOUSEHOLD ACTIVITY DATA SUMMARY - ACTIVITY TIME--HOUSEWORK TIME VARIATION.

Activity	Minutes per Day Variation from Average				Remarks
		(N)	Women	(N)	Men
Factors influencing housework time variation	Total Sample Average		247 min.		52 min.
	Standard Deviation		155 min.		81 min.
	Personal Factors				
	Education				
	Grade school	(126)	+14	(129)	-6
	Some high school	(216)	+4	(187)	+1
	High school graduate	(492)	+2	(304)	0
	Some college	(154)	-24	(135)	-6
	College graduate	(109)	+6	(141)	+16
	Age				
	18-29	(307)	-30	(241)	-7
	30-39	(251)	-8	(198)	-4
	40-49	(264)	+19	(228)	+3
	50-69	(67)	+24	(233)	+8
	Race				
	White	(1013)	0	(835)	0
	Black	(79)	-7	(55)	+1
	Religion				
	Catholic	(299)	-2	(233)	-3
	Jewish	(42)	-26	(23)	-23
	Established Protestant	(155)	+4	(105)	+11
	Traditional Protestant	(503)	+2	(418)	-1
	Modern Protestant	(76)	+8	(70)	+3
	None, other	(29)	-1	(53)	0
	Role Factors				
	Employment				
	Yes	(534)	-59	(865)	-2
	Student	(10)	-100	(18)	+5
	No	(558)	+58	(19)	-3
	Spouse employment				
	Yes	(811)	+8	(248)	+5
	No	(30)	+43	(509)	-1
	Not married	(251)	-29	(140)	-1
	Family composition				
	No children	(422)	-32	(323)	-3
	At least one child under four years				
	One	(60)	-10	(51)	-10
	Two	(70)	+10	(71)	+7
	Three	(54)	+31	(45)	-6
	Four	(74)	+64	(58)	+8

Multiple Classification Analysis (MCA) is a multivariate regression program developed at the Survey Research Center by Andrews, Morgan and Sonquist (1969) to assess the impact of particular variables after control for the effects of other predictor variables. (Robinson, Op Cit, Page 65)

TABLE 49. HOUSEHOLD ACTIVITY DATA SUMMARY - ACTIVITY TIME--HOUSEWORK TIME VARIATION (CONTINUED).

Activity	Minutes per Day Variation from Average				Remarks
	(N)	Women	(N)	Men	
All children over four years					
One	(130)	+3	(114)	-2	
Two	(137)	+13	(129)	+2	
Three	(93)	+26	(68)	+7	
Four	(54)	+43	(41)	-10	
Environmental Factors					
City size					
Large city	(131)	+25	(98)	+3	
Medium city	(156)	-32	(138)	+3	
Large suburb	(185)	+16	(134)	-1	
Medium suburb	(186)	-3	(139)	-7	
Outlying areas	(42)	+42	(32)	+1	
Metropolitan area					
New York	(105)	-16	(72)	-16	
Los Angeles; Chicago	(86)	-28	(67)	+6	
Other large cities	(186)	+9	(138)	+2	
Medium cities	(182)	+5	(161)	-6	
Smaller cities	(103)	-4	(103)	-2	
Jackson, Michigan	(361)	+1	(361)	+2	
Day of Week					
Weekday	(775)	0	(651)	-11	
Saturday	(155)	+25	(113)	+33	
Sunday	(156)	-31	(138)	+25	
Season					
Fall	(770)	+4	(611)	+1	
Spring	(333)	-10	(291)	-3	
Resource Factors					
Income					
Under $1,000	(120)	0	(46)	+4	
$1,000-5,999	(200)	+13	(132)	+3	
$6,000-9,999	(446)	+1	(382)	+2	
$10,000-14,999	(215)	-17	(316)	-5	
$15,000 and over	(94)	+13			
Paid help					
None	(857)	+1		-	
Infrequent	(119)	+12		-	
Part-time	(215)	-11		-	
Full-time	(19)	-33		-	

Reference: (49) Robinson, 1956 and 1973, Midwestern householders.

TABLE 50. HOUSEHOLD ACTIVITY DATA SUMMARY - ACTIVITY TIME--MEAL PREPARATION.

Activity	Source of Data	Complexity Level of Meals					Remarks
		Type	Description	Number of operations	Average time used to prepare (Average hours) Median	Mean	% Freq.*	
Meal Complexity Range	Two day records on 1,296 husband-wife households Syracuse, N.Y. 1967-68 (2,592 "record days"), ages <25 to >55 and frequency of preparation of meals	1	Very Simple Meals Ready prepared foods (babies' bottles or meals; snacks of already prepared food; some sandwiches); noncooking or cooking operations only, or combined simple cooking and noncooking operations.	0-3	.2	.2	2	* Percent of 2,584 record days (excludes 8 record days in which no meals were served) on which each type of meal was meal of highest complexity, e.g., for 7% of the days a type 5 meal was the most complex meal prepared.
		2	Simple Meals Quickly prepared foods requiring somewhat more handling than those in Type 1 meals (leftovers warmed up; buttered toast and coffee); noncooking operations only or combined cooking and noncooking operations.	4-7	.3	.3	21	
		3	Intermediate Meals Partially prepared foods (salad and sandwich; packed lunches); largely combined cooking and noncooking operations.	8-14	.5	.6	43	
		4	Moderate complex Meals Meals with 1 or 2 menu items that require some preparation at home; practically all combined cooking and noncooking operations.	15-24	.9	.9	27	
		5	Complex Meals Meals containing at least one totally home-prepared dish, such as a pie or cake or consisting of a complex menu with several items requiring home preparation; all a combination of noncooking and cooking operations.	25 or more	1.4	1.5	7	
Reference (75)	Walker and Woods, 1967							

TABLE 51. HOUSEHOLD ACTIVITY DATA SUMMARY--CHILD CARE TIME.

Activity	Minutes per Day

Direct child care activity

	Employed Men				Employed Women				Housewives			
	M-F	Sat	Sun	Total	M-F	Sat	Sun	Total	M-F	Sat	Sun	Total
Basic child care												
Baby care	2	4	5	2	6	7	7	6	39	27	29	36
Child care	1	1	4	1	9	4	3	7	26	8	15	22
Child health	0	0	0	0	1	0	0	1	2	1	0	1
Other child care												
Help with study	–*	0	2	1	2	0	0	2	6	1	2	4
Talk to child	1	0	1	1	1	–	5	1	5	0	1	3
Indoor play	4	5	10	5	1	0	1	1	4	2	6	4
Outdoor play	1	0	1	1	–	0	0	–	1	1	0	0
Other, baby-sit	1	2	–	1	4	3	0	3	3	6	4	4
Total Hours per Week	.8 +	.2 +	.4 =	1.4	2.0 +	.2 +	.3 =	2.5	7.1 +	.7 +	.9 =	8.7
Total Hours per Day of Housework**	1.3	2.5	2.5	1.6	3.8	5.4	4.1	4.1	8.4	6.9	4.7	7.6
Total Hours per Week of House-work	6.3 +	2.5 +	2.5 =	11.3	18.6 +	5.4 +	4.1 =	28.1	38.9 +	6.4 +	4.5 =	53.2

Reference (49) Robinson, 1956, Midwestern householders; N=generally 2000 male and female

TABLE 52. HOUSEHOLD ACTIVITY DATA SUMMARY--PERSONAL TIME.

Activity	Minutes per Day

Personal care

	Employed Men				Employed Women				Housewives			
	M-F	Sat	Sun	Total	M-F	Sat	Sun	Total	M-F	Sat	Sun	Total
Personal care												
Personal service	1	3	0	1	1	11	0	2	3	0	0	2
Medical service	1	4	0	1	1	1	0	1	3	–	1	2
Personal hygiene	45	52	42	46	56	64	70	59	51	59	54	52
Personal medical	–	–	1	–	–	0	0	–	1	0	–	1
Private, other	9	18	12	11	12	19	24	15	18	15	14	17
Eating												
Meals at work	21	7	3	16	18	6	2	14	–	0	0	–
Meals, snacks	54	59	71	57	46	55	54	48	73	65	64	71
Restaurant meals	15	25	12	16	9	17	5	10	6	7	6	6
Sleep												
Night sleep	439	452	522	453	436	469	533	455	456	475	495	464
Day sleep	9	15	18	11	9	9	34	12	9	8	14	9
Total Hours per Day	9.9	10.6	11.3	10.2	9.8	10.8	12.0	10.3	10.3	10.5	10.8	10.4
Total Hours per Week	49.3 + 10.6 + 11.3 = 71.4				49.8 + 10.8 + 12.0 = 72.0				51.6 + 10.5 + 10.8 = 72.9			

Reference: (49) Robinson, 1956, Midwestern householders
N=generally 2000 male and female

TABLE 53. HOUSEHOLD ACTIVITY DATA SUMMARY--ACTIVITY TIMES--FREE TIME.

Activity	Percent of Free Time

Free time Use

	Employed Men (N = 520)	Employed Women (N = 342)	Housewives (N = 355)
Leisure travel	7	6	6
Study	4	3	1
Religion	3	4	4
Organizations	2	1	3
Radio	2	2	1
TV (home)	35	26	28
TV (away)	– *	1	–
Read paper	9	6	6
Read magazines	2	3	2
Read books	1	2	2
Movies	1	1	1
Social (home)	7	12	10
Social (away)	12	12	12
Conversation	4	7	8
Active sports	3	2	1
Outdoors	1	–	1
Entertainment	2	3	1
Cultural events	–	–	–
Rest	2	4	4
Other leisure	3	7	10
Total Free Time	100	100	100

Reference: (75) Robinson, 1956, Midwestern householders

TABLE 54. HOUSEHOLD ACTIVITY DATA SUMMARY - EQUIPMENT UTILIZATION--HEATING AND COOLING.

Activity	Percent of Respondents Reporting Use
Heating and cooling equipment in dwellings	

Equipment	Total group
	Percent
Heating equipment	
Automatic	98
Warm-air furnace	84
Steam heat	13
Built-in electric	1
Space heater	1
Other	1
Air conditioning	
None	80
1 unit	14
2 or more units	3
Central	3
Fireplace	
Owned	29
Used on record days	2

Reference: (75) Walker and Woods, 1967-68, Syracuse, N.Y.
N=1296 husband and wife householders

TABLE 55. HOUSEHOLD ACTIVITY DATA SUMMARY--EQUIPMENT UTILIZATION--KITCHEN EQUIPMENT.

Activity	Percent of Respondents Reporting Use
Use of kitchen equipment	

Equipment	Number	All households (1,296)	Nonemployed-wife households (979)	Employed-wife households (317)
		Percent		
Oven		59	60	55
Kitchen exhaust fan		30	31	26
Electric mixer, blender		28	30	25
Disposer		27	23	20
Electric fry pan, griddle, fryer		18	20	15
Broiler		16	16	15

Reference: (75) Walker and Woods, 1967-68, Syracuse, N.Y.

TABLE 56. HOUSEHOLD ACTIVITY DATA SUMMARY--EQUIPMENT UTILIZATION--CLOTHING CARE.

Activity	Percent of Respondents Reporting Use

Equipment used for clothing care

Equipment	All households (N = 1,296)	Nonemployed-wife households (979)	Employed-wife households (317)
	Percent		
Washing by machine			
No equipment used on record days	40	38	46
Automatic washer	57	59	50
Combination washer-dryer	1	1	1
Dryer	42	44	37
Nonautomatic washer	3	3	2
Commercial laundry	3	3	2
Diaper service	3	4	1
Paid help for washing	1	1	2
Special clothing care			
Sewing equipment	30	31	26
Commercial drycleaning	6	7	4
Coin-operated drycleaning	<1	<1	<1

Reference: (75) Walker and Woods, 1967-68, Syracuse, N.Y.

TABLE 57. HOUSEHOLD ACTIVITY DATA SUMMARY - TASK DIFFICULTY FACTORS--COGNITIVE.

Activity	Frequency of Judgments of Tasks as High or Low Cognitive	Remarks
Cognitive task requirements		*Task descriptions in which 208 respondents named 3 high cognitive tasks and 3 low cognitive tasks, i.e., 3 x 208 = 624 task descriptions each category.

Tasks	High Cognitive Tasks		Low Cognitive Tasks	
	Number	Percent	Number	Percent
Total	624 *	100	624 *	100
Food	241	39	131	21
Meal preparation, cooking, planning meals	164		11	
Food marketing	60		5	
Washing dishes	1		103	
Other and combinations	16		12	
Shelter	86	14	299	48
Cleaning (heavier)--weekly and seasonal cleaning, floors, vacuuming	42		164	
Cleaning (lighter)--beds, dusting, straightening	3		109	
Interior decorating, arranging, buying	22		3	
Other and combinations	19		33	
Clothing	70	11	145	23
Laundry, washing clothes	26		79	
Ironing	15		63	
Sewing	16		3	
Other and combinations	13		10	
Family, personal	145	23	17	3
Baby care, child care, upbringing	100		3	
Husband care, trips, family outings, pets	22		4	
Entertaining	18		1	
Personal--free time usage, leisure, personal care	6		9	
Management*	64	10	4	1
Budgeting	20		0	
Planning schedule and time, organizing	18		2	
Shopping, spending money wisely, paying bills, errands	26		2	
Other	18	3	28	4

Reference: (60) Steidl, 1967, Urban housewives

TABLE 58. HOUSEHOLD ACTIVITY DATA SUMMARY - TASK DIFFICULTY FACTORS--WORK CONSTRAINT.

Subject	Task Constraint Ratings	Remarks
Task difficulty factors-general		*More constraining-personally demanding or limiting **Less constraining-less requirements imposed on the worker.

Difficulty Factors	High Cognitive Tasks (N = 622) Number of Responses	Percent of Total	Percent of Subtotal	Low Cognitive Tasks (N = 414)[a] Number of Responses	Percent of Total	Percent of Subtotal
Q8 Work made more difficult						
All responses	1,236	100		803	100	
More constraining *	1,095	89		670	83	
House	580		93	361		54
Community	104		9	28		4
Family	87		8	41		6
Timing	110		10	38		8
Money	40		4	3		+
Quality/quantity	0		0	0		0
Difficulty	118		11	160		24
Process	8		1	5		1
Affective (general)	12		1	20		3
Cognitive (general)	58		5	14		2
Less constraining **	141	11		133	17	
Q9 Work made less difficult						
All responses	1,165	100		803	100	
More constraining *	132	11		102	13	
Less constraining **	1,033	89		701	87	
House	506		49	406		58
Community	137		13	33		5
Family	97		9	38		6
Timing	54		5	24		3
Money	20		2	5		1
Quality/quantity	0		0	0		0
Difficulty	139		13	163		23
Process	1		+	0		0
Affective (general)	39		4	15		2
Cognitive (general)	40		4	18		3

Reference: (60) Steidl, 1967, Urban housewives

TABLE 59. HOUSEHOLD ACTIVITY DATA SUMMARY -- TASK DIFFICULTY FACTORS--HOUSING AND EQUIPMENT.

Activity	Difficulty Factors in High & Low Cognitive Tasks
Housing and equipment factors in task difficulty	

	Number of Responses	
Difficulty Level and Explanation	*High Cognitive Tasks*	*Low Cognitive Tasks*
Q8. Work made more difficult:	580	361
Inadequate, inconvenient work surface	80	21
Inadequate, inconvenient storage space	58	28
Inadequate equipment, supplies	91	69
Lack of equipment, supplies	39	39
Location of equipment, task	22	20
Furniture, furnishings not pleasing	22	32
Crowded, cluttered space, number of rooms	135	63
Arrangement of rooms	26	10
Adverse effects of housing on temperature, light, ventilation, sound, safety	40	24
Quality of housing structure, age	20	21
Other	48	36
Q9. Work made less difficult:	506	406
Adequate, convenient work surface	28	17
Adequate, convenient storage space	32	16
Good quality equipment, supplies	105	109
Have equipment, supplies	80	60
Location of equipment, task	24	23
Furniture, furnishings pleasing	15	35
Adequate space, number of rooms	92	76
Arrangement within and among rooms	56	23
Favorable effects of housing on temperature, light, ventilation, sound, safety	36	18
Quality of housing structure, age	15	24
Other	24	14

Reference: (60) Steidl, 1967, Urban housewives

TABLE 60. HOUSEHOLD ACTIVITY DATA SUMMARY--TASK DIFFICULTY FACTORS--COMPLEXITY, DIFFICULTY, PREFERENCE.

Activity	Factor Ratings of High and Low Cognitive Tasks			
Task preference, complexity and difficulty		High Cognitive Tasks (N = 612)		Low Cognitive Tasks (N = 596)
	Factor and Rating	Number	Percent	Number	Percent
	Complexity				
	Complicated	401	66	27	5
	Uncomplicated	211	34	569	95
	Difficulty				
	Difficult	290	47	46	8
	Easy	322	53	550	92
	Preference				
	Liked	510	83	289	48
	Disliked	102	17	307	52

Reference: (60) Steidl, 1967, Urban housewives

Bibliography

1. Anthropometry of women of the U.S. Army - 1977, Report No. 2, TR-771021 - U.S. Army, Natick Research and Development Command, Natick, Mass., June 1977.

   A summarization of univariate statistics from an anthropometry survey of 1,331 women in the U.S. Army with special subsamples of 200 - 300 women for special measurements.

2. Avery, A.C. The use and abuse of equipment. Food Management, February 1973, pp. 64-67; 81 and 89.

   A discussion of imaginative utilization and hazards of ovens, deep fat fryers, fry pan, steam jacketed kettles, steamer and pressure cookers, and vertical cutter mixers in institutional kitchens.

3. Bean, P. Patterns of self poisoning. British Journal of Preventive Medicine 1974, 28, pp. 24-31.

4. Becker, F.D. Housing Messages. Stroudsberg, Pa: Dawden, Hutchinson, and Ross, Inc., 1977.

   Addressed to public or development housing design, this book discusses human interaction with the building environment.

5. Bednar, M.J. (ed.) Barrier free environments. Stroudsberg, Pa: Dawden, Hutchinson, and Ross, Inc., 1977.

   A collection of papers on general and specific considerations and programs in removing physical and social environmental barriers to the handicapped.

6. Bell, E., Jurek, K., Wilson, O.T.R. Handskill measurement, a gauge for treatment. American Journal of Occupational Therapy. 1976, 30(2), pp. 80-86.

7. Bennett, C. Spaces for people: Human factors in design. Englewood Cliffs, N.J.,: Prentice Hall, Inc., 1977.

   This book deals with interior design and design criteria needed to satisfy human needs, with designs of spaces for varying numbers of people, and with principal environmental aspects of interior spaces.

8. Body dimensions and proportions, white and negro children six through eleven years. United States Vital and Health Statistics, Data from the National Health Survey, U.S. Department of Health, Education, and Welfare, Public Health Service, Washington, D.C., December 1974.

A report on 20 anthropometric dimensions of children six through eleven years of age in the United States analyzed by race, age and sex.

9. Bratton, E.C. Some factors of cost to the body in standing or sitting to work under different postural conditions. Journal of Home Economics, 1958, 50(9), 711-715.

An analysis of energy cost and angle of underarm lift for standing and sitting to work at work surface of various heights. Note: No N-shown, subjects only identified as young homemakers of height and weight and in good health, probably women.

10. Brook, M.W.V. Home management for the adult mentally retarded in a sheltered workshop. (Doctoral dissertation, University of Wisconis, 1976). Dissertation Abstracts International, 1976. (University Microfilms No. 76-18, 912).

A study of fifty-six adult mental retardates to determine effect of education on development of skills required to become independent in the community, namely care of clothing, cleaning, repair and storage.

11. Brown, W.C. & Buchanan, C.J. A study of the strength capabilities of children ages two through six. NBSIR 73-156, Consumer Product System Section, Measurement Engineering Division, Institute for Applied Technology, National Bureau of Standards, Washington, D.C., August 1973.

A study of strength of 556 children using a push-pull test two twist testers and a squeeze force tester.

12. Brown, W.C. & Buchanan, C.J. A study of young children's pull apart strength (An addendum to NBSIR 73-156, A study of strength capabilities of children ages two through six) NBSIR 73-424. Consumer Product Section, Institute for Applied Technology, National Bureau of Standards, Washington, D.C., April 1974.

A study of pull apart strength of 500 children pulling handles apart parallel to the shoulders and perpendicular to the shoulder.

13. Damon, A., Stoudt, H.W. & McFarland, R.W. The Human Body in Equipment Design. Cambridge, Mass.: Harvard University Press, 1971.

A human engineering systems design guide primarily oriented toward anthropometry and biomechanics.

14a. Davis, P.R. and Stubbs, D.A. Safe levels of manual forces for young males (1). Applied Ergonomics 1977, 8(3), pp. 140-150.

14b. Davis, P.R. and Stubbs, D.A. Safe levels of manual forces for young males (2). Applied Ergonomics 1977, 8(4), pp. 219-228.

15. Design criteria, new public building accessibility. PBS(PCD): DG5, General Service Administration, Public Buildings Service, Washington, D.C., May 1977.

Recommendations for making buildings and facilities accessible to handicapped individuals. Includes basic disability anthropometry and recommendations for access to, within and around public buildings by the handicapped.

16. A design guide for home safety. U.S. Department of Housing and Urban Development, Washington, D.C.

A design guide for safer homes with a series of safety checklists for each area of the home: stairs, bathrooms, windows, doors, kitchens, floors, electrical systems, and exterior environs.

17. Eddy, T.P. Deaths from falls and fractures - comparison of the mortality in the U.S. with that in England and Wales. British Journal of Preventive and Social Medicine 1973, 27, pp. 247-254.

18. Eddy, T.P. Deaths from domestic falls and fractures. British Journal of Preventive and Social Medicine 1972, 26, 273-179.

19. Eggleston, C. An Exploratory Study of Home Safety Practices. Unpublished doctoral dissertation, University of New Jersey, 1973.

A study of safety knowledge of low income families and the features of low income homes contributing to accidents.

20. Elfant, I.E. Correlation between kinesthestic discrimination and manual dexterity. American Journal of Occupational Therapy, 1977, 33(1), pp. 23-28.

21. Finley, F.R., Cody, K.A., Finizie, R.V. Locomotion patterns in elderly women. Presented at Forty-fifth Annual Session of the American Congress of Rehabilitation Medicine, Miami Beach, Fla., August 30, 1967.

22. Fitzimmons, C., Goble, E. and Minter, E.M. Easy ways. Extension Circular 512, Cooperative Extension Service, Purdue University, Lafayette, Ind., March 1966.

A report on work simplification in several household tasks by individual homemakers.

23. Goldsmith, S. Designing for the disabled (3rd ed.). London, England: RIBA Publications, Ltd., 1976.

A basic text for designing for the disabled with major but not exclusive emphasis on wheelchair disabled. Includes basic anthropometry and building and facility design and layout data.

24. Gries, J.M. and Ford, J. (eds.) Household Management and Kitchens. The President's Conference on Home Building and Home Ownership, 1931, Washington, D.C.

This book gathers the known information on household management and kitchens and other work centers into one volume. Criteria for management and for equipment are defined.

25. Guilford, J.S. Prediction of accidents in a standardized home environment. Journal of Applied Psychology, 1973, 37(3), pp. 306-313.

26. Hayward, D.G. Psychological concepts of home among urban middle class families with young children. (Doctoral dissertation, Michigan State University, 1973). Dissertation Abstracts International, 1973. (University Microfilms No. 77-11, 173).

A study of the concept "home" and how the housing environment affects an individual's satisfaction, self-esteem and well being. The results represent an overview of the psychological meanings of "home."

27. Hearing sensitivity and related medical findings among children in the United States. Data from the National Health Survey, Series 11, No. 14, Department of Health, Education and Welfare Publication No. (HSM) 72-1046, U.S. Department of Health, Education and Welfare, Public Health Service, March 1972.

28. Kimura, P.S. Family Activity Patterns as a Basis for House Design. Unpublished Masters' dissertation, Purdue University, June 1970.

An analysis of interviews on and records of family activity patterns among eleven Japanese-American families in Hawaii for two 24-hour days in relationship to house layout and room use. Includes a comparison observation, interview and record keeping as data collection procedures. Housing was one story, single family structures.

29. "Kitchens" from a design guide for home safety. U.S. Department of Housing and Urban Development, Washington, D.C., January 1972.

This chapter makes several recommendations for a safe, well-planned kitchen which minimizes the opportunity for accidents.

30. Kramer, J.J. and Meguire, P.G. Consumer product portability as related to warranty rule making. NBSIR 76-1092, Human Factors Section, Center for Consumer Product Technology, National Bureau of Standards, Washington, D.C., August 1976.

A report on an experimental study of weight carrying to establish a reasonable product weight for consumer product portability.

31. Kvalseth, T.A. Comparison between information rates generated by rotary hand and arm movements. Perceptual and Motor Skills, 1976, 42, pp. 1115-1118.

32. Lang, J., Burnette, C., Moleski, W., and Vachon, D. Designing for Human Behavior: Architecture and the Behavioral Sciences. Stroudsberg, Pa: Dawden, Hutchinson, and Ross Inc. 1974.

This book discusses why modern architecture fails to meet users' needs and discusses seven architects views which cover three areas: the nature of the problem, new ways to program, design and evaluate buildings, and the interface between architecture and environmental psychology.

33. Laubach, L.L. Muscular strength of men and women: A comparative study, AMRL-TR-75-32. Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio, May 1976.

An analysis of static muscular strength data obtained from three young female subjects as compared with similar muscular strength data previously (1969) obtained from a group of young men by other investigators. A summary of strength related literature data is also included.

34. Linder, R.L. and Lerner, S.E. Self-medication and the Only Child. Journal of Drug Education, 1972, 2(4), pp. 361-370.

A study of 839 students' birth order versus ingestion of various psychoactive (alcohol, tobacco, LSD, etc.) drugs without medical supervision.

35. Lucht, U. A perspective study of accidental falls and resulting injuries among elderly people. Acta Socio-Medica Scandinavia, 1971, 2, pp. 105-120.

36. Maloch, F. Properties, qualities, and characteristics of most and least liked household tasks. Cornell University, Agricultural Experiment Station, New York State College of Home Economics, Ithaca, NY, Memoir 384, July 1963.

An analysis of task like and dislike based on ratings of task characteristics by 120 Binghamton, NY "middle" and "lower middle" class homemakers.

37. Manning, S.L. Time use in Household Tasks by Indiana Families. Research Bulletin, 837. Purdue University Agricultural Experiment Station, Lafayette, Ind. Project No. 1169, January 1968.

An analysis of one week's daily time records from 111 Indiana families, tour times during the year 1961-62.

38. Matthews, J.J. Functional assessment of perceived mental and physical health, social and economic resources, activities of daily living, and needed services of elderly participants and non participants of the Columbus, Ohio congregated meals program. (Doctoral dissertation, Ohio State University, 1976). Dissertation Abstracts International, 1976. (University Mifrofilms No. 77-2, 455).

Examination of a Federal program for the aged, congregate meals, to identify the level of functioning of participants, drop-out, and non participants in the program.

39. Mortality from fires and conflagrations. Statistical Bulletin December 1975, pp. 6-9.

40. National Safety Council, Accident Facts 1977 edition, Chicago.

41. Neely, E. and Patrick, M.L. Problems of aged persons taking medication at home. Nursing Research 1968, 17(1), pp. 52-55.

42. Neutra, R. and McFarland, R.A. Accident epidemiology and the design of the residential environment. Human Factors, 1972, 14(5), 405.

The design of the home in the near future can have a positive or negative impact on the safety of its occupants. This is a review of studies of fire, pedestrian accidents and poisoning that attempted to quantify the effect of design elements on accidents.

43. Owings, C.L. Strength characteristics of U.S. children for product safety design, Final Report, Consumer Product Safety Commission, Washington, D.C., October 1975.

A study of muscular strength of 502 children between the ages of two and ten years. The study reports on 33 isometric exertion measurements involving torque, hand grip and punch.

44. Parsons, H.M. The Bedroom. Human Factors, 1972, 14(5), 421-450.

A review of the major and minor uses of the bedroom from a human engineering view.

45. Pickering, E. Shelter for Living. New York: John Wiley and Sons, Inc. 1941.

This book presents a functional approach to the design of a home for family life in a single family home.

46. Raschko, B. Physiological and Behavioral Characteristics of the Elderly: A Basis for Design Criteria for Interior Space and Furnishings. Rehabilitation Literature 1974, 35(1).

47. Reynolds, H.M. and Allgood, M.A. Functional Strength of Commercial Airline Stewardesses. FAA Civil Aeromedical Institute, Oklahoma City, Oklahoma, November 1975.

Reported data from thirteen body measurements and four strength tests of 152 female flight attendants.

48. Robinson, J.P. Changes in Americans' Use of Time: 1965-1975: A Progress Report, Communications Research Center, Cleveland State University, Cleveland, Ohio, August, 1977.

The use of time is shown to differ between 1965 and 1975 based on comparisons of time diary studies done in 1965 and 1975. Study excludes rural residents, unemployed, retired, farmers and those over 65.

49. Robinson, J.P. How Americans Use Time: A Social Psychological Analyses of Everyday Behavior. New York: Praeger Publishers, 1977.

An analysis of use of time by 2,000 Americans, characterized as urban and employed, between ages of 18 and 65. Data was collected between Fall of 1965 and Spring of 1966 on one day's activities.

50. Rozier, C.K. Three dimensional Work Space of the Amputee. Human Factors, 1977, 19(5), pp. 525-533.

A report of a study of three dimensional search work space of twenty male above and below elbow amputees. Data are reported for representative normal and for prosthetic extremities.

51. Selected body measurements of children six through eleven years--United States. Vital and Health Statistics from the National Health Survey. Series 11, No. 123, U.S. Department of Health, Education and Welfare, Public Health Service, January, 1973.

A report on measurement o twenty-one anthropometric dimensions of children six through eleven years old, 1963-65.

52. Sitkei, E.G. Systematic planning and programming for group homes and handbook for operators. Rehabilitation Research and Training Center in Mental Retardation, University of Oregon, Eugene, OR. February,1976.

This gives both a rationale and a guide for systematic management of group homes.

53. Snow, C.C., Reynolds, H.M. and Allgood, M.A. Anthropometry of Airline Stewardesses. FAA-AM-75-2, FAA Civil Aeronautics Institute, Oklahoma City, Oklahoma, March 1975.

A report of body measurements of 423 stewardesses trainees enrolled in the American Airline Stewardess Training Academy, Forth Worth, Texas, between February and June 1971.

54. Snyder, R.G., Spencer, M.L., Owings, C.L., Schneider, L.W. Anthropometry of U.S. infants and children SP-394, 1975

A report of the results of a three year anthropometric study of 4,027 United States infants and children from newborn to twelve years of age.

55. Snyder, R.G., Schneider, L.W., Owings, C.L., Reynolds, H.M., Golomb, D.H. and Schork, M.A. Anthropometry of infants, children and youths to age eighteen for product safety design, Final Report. WM-HSRI-77-17 Highway Safety Research Institute, University of Michigan, May 31, 1977.

A report of 87 body measurements from a sample of 4,127 U.S. infants, children and youths aged two weeks to eighteen years.

56. Somer, R. Tight Spaces; Hard Architecture and How to Humanize it. Englewood Cliffs, NJ: Prentice Hall, Inc., 1974.

Somer discusses the assumptions behind hard architecture, its effect on human occupants, and what can be done to humanize the built environment.

57. Stefl, M.E., Goodman, P.C., Ramey, A.M., and Bents, F.D. Accidents involving small selected appliances: Summary and descriptive analysis. National Bureau of Standards, Washington, D.C., December 1975. (NBSIR 75-969).

An analysis of accident reports for appliance listed in top 50 of the Consumer Product Safety Commission Hazard Index for 1974.

58. Steidl, R.E. Complexity of Home Making Tasks. Home Economics Research Journal, 1975, 3(4), pp. 223-240.

A study of ratings of 208 young wives of cognitive demands of homemaking tasks associated with food, shelter, clothing, family and general management.

59. Steidl, R.E. Continuity of Household Work. Memoir 383, Agricultural Experiment Station, Cornell University, Ithaca, NY, June 1963.

A study of data from a 1952 study of the use of time by 248 homemakers recorded to reflect continuity of work by blocks of time. (Note: Continuity is not clearly shown in the data).

60. Steidl, R.E. Difficulty factors in homemaking tasks: Implications for environmental design. Human Factors, 1972, 14(5), pp. 471-482.

A study of homemakers' opinion on the sources of difficulty in home tasks they rated as high and low in cognitive requirements.

61. Steidl, R.E. Food tasks, complexity, difficulty, preference. Home Ecology Forum, 1972, 3(1).

A report on the judgment of homemaking tasks as being high or low in attention, judgment and planning by 208 housewives, mean age 24.

62. Steidl, R.E. Functional Kitchens. Cornell Extension Bulletin 1166, New York State College of Human Ecology, Cornell University, Ithaca, NY, July, 1969.

A guide for planning kitchens for efficient location and design of work centers and facilities therein.

63. Steidl, R.E. Use of time during family meal preparation and cleanup. Journal of Home Economics, 1958, 30(6), pp. 447-450.

A study of the amount of time spent in the kitchen, and where in the kitchen during meal preparation and cleanup during preparation of breakfast and dinner menus.

64. Steidl, R.E. What Makes Homemaking Tasks Complicated? New York State College of Human Ecology, Cornell University, Ithaca, NY, March, 1974. (College Project 402).

A report on the source of homemaking task complexity as cited by 208 housewives, mean age 24.

65. Steidl, R.E. and Bratton, S.C. Work in the Home. John Wiley and Sons, New York, 1968.

66. Szalai, A. (ed.) The Use of Time: Daily Activities of Urban and Suburban Populations in Twelve Counties. Mouton and Co., The Hague, Paris. 1972.

67. Thorndike, E.L. How We Spend Our Time and What We Spend It For. The Scientific Monthly, 1937, 44, 464-469.

A discussion of the use of time by working girls and an estimate on the use of time according to a panel of psychologists and the author.

68. Tokuhata, G.K., Colflesh, N., Smith, R.N., Rameswamy, K., Digon, E. Consumer Behavior and Product Injuries. Journal of Safety Research, 1976, 8(3), pp. 116 - 125.

69. Van Cott, H.P. and Kinkade, R.G. Human Engineering Guide to Equipment Design. (Rev. ed.). Los Angeles, CA: McGraw Hill, 1972.

A human engineering system design guide primarily focused on human capabilities and requirements data for utilization of military systems.

70. Vaughn, J.L. Standardized estimates of time required and quality of various tasks in household employment. Purdue Research Foundation, Purdue University, Lafayette, Ind., January, 1972.

A study of furniture dusting and floor vacuuming to develop a formula for estimating the components in and time required for the dusting and floor vacuuming in cleaning house. Thirty-two houses were studied. A regression equation for estimated time is presented.

71. Walker, K.E. How Much Help for Working Mothers? Human Ecology Forum, 1970, 1(2).

An analysis of the amou of time contributed by school age children to household work.

72. Walker, K.E. Time Use Homemaking Work. Presented at 14th Closta Congress, Helsinki, July 1968. (Available from New York State College of Human Ecology, Cornell University, Ithaca, NY).

An analysis of time used in homemaking in New York State, The Netherlands, and Sweden in relation to family size and employment.

73. Walker, K.E. Time Use Patterns for Household Work Related to Homemakers' Employment. Presented at National Agricultural Outlook Conference, Washington, D.C., February 18, 1970. (Reproduced by U.S. Department of Agriculture, Agricultural Research Service).

A time record study of housework performed by members of families in relation to employment of homemakers.

74. Walker, K.E. Time Used by Husbands for Household Work. Family Economics Review, 1970.

An analysis of the amount of time spent by husbands of employed vs non employed wives on household work.

75. Walker, K.E. and Woods, M.E. Time Use: A Measure of Household Production of Family Goods and Services. Center for the Family of the American Home Economics Association, Washington, D.C. 1976.

76. Walker, K.E. and Gauger, W.H. Time and Its Dollar Value in Household Work. Family Economics Review, Fall, 1973.

An analysis of the dollar value of housework based on the kind and hours of work performed by family members and the price of the work in the labor market.

77. Weight, Height and Selected Body Dimensions of Adults in the United States, 1960-1962. Vital and Health Statistics Data from the National Health Survey, Series 11, No. 8. U.S. Department of Health, Education and Welfare, Public Health Service, June 1965.

A report on findings on certain of the physical measurements of adults obtained in the first cycle of the Health Survey.

78. Werber, M. Home Accidents and Safety. Psychology Search Association, Silver Spring, Md., for National Bureau of Standards, NBS-GCR 76-76, September, 1975.

A summarization of published research on home accidents and safety with abstracted and non abstracted bibliography.

79. Weschler, H., Kasey, E.G., Thom, D., and Demone, H.W. Alcohol Level and Home Accidents. Public Health Reports, 1969, 84(12), pp. 1043-1050.

80. White, R.M. and Churchill, E. The Body Size of Soldiers: U.S. Army Anthropometry - 1966, TR-72-51-CE, Army Natick Laboratories, Natick, Mass. December 1971.

A report of the U.S. Army anthropometric survey of 1966 on 6,682 Army basic trainees, infantry men, armed crew men and aviation personnel.

Appendix A

Organizations of the Disabled Contacted for this Report

American Academy for Cerebral Palsy
1255 New Hampshire Avenue, N.W.
Washington, D.C. 20036
202-659-8251

American Academy on Mental Retardation
916 64th Avenue East
Tacoma, WA 98424
206-922-5859

American Association on Mental Deficiency
5201 Connecticut Avenue, N.W.
Washington, D.C. 20015
202-686-5400

American Council of the Blind
1211 Connecticut Avenue, N.W.
Suite 506, Washington, D.C. 20036
202-833-1251

American Foundation for the Blind, Inc.
15 W. 16th Street
New York, NY 10011
212-924-0420

American Speech and Hearing Association
9030 Old Georgetown Road
Washington, D.C. 20014
202-897-5700

Arthritis Foundation
3400 Peachtree Road, N.E.
Suite 1101
Atlanta, GA 30326

Committee to Combat Huntington's Disease
250 W. 57th Street
Suite 2016
New York, NY 10019
212-757-0443

Cystic Fibrosis Foundation
3379 Peachtree Road, N.E.
Atlanta, GA 30326
404-262-1100

Epilepsy Foundation of America
1828 L Street N.W.
Washington, D.C. 20036
202-293-2930

Little People of America
P.O. Box 126
Owatonna, MN 55060
507-451-1320 (Dwarfism)

Muscular Dystrophy Assoc., Inc.
810 Seventh Avenue
New York, NY 10019
212-586-0808

Myasthenia Gravis Foundation
230 Park Avenue
New York, NY 10017
212-986-9487

National Amputation Foundation
12-45 150th Street
Whitestone, NY 11357
212-767-0596

National Association of the Deaf
814 Thayer Avenue
Silver Spring, MD 20910
301-587-1788

National Epilepsy League
Six N. Michigan Avenue
Chicago, IL 60602
312-332-6888

National Hemophilia Foundation
25 W. 39th Street
New York NY 10018
212-869-9740

National Multiple Sclerosis Society
205 E. 42nd Street
New York, NY 10017
212-986-3240

National Paraplegia Foundation
369 Elliot Street
Newton Upper Falls, MA 02164
312-346-4779

National Parkinson Foundation
1501 N.W. Ninth Avenue
Miami, FL 33136
305-324-0156

National Society for Autistic Children
306 31st Street
Huntington, WV 25702
304-697-2638

Orton Society
8415 Bellona Lane
Towson, MD 21204
301-296-0232 (Dyslexia)

Parkinson's Disease Foundation, Inc.
William Black Medical Research Bldg.
Columbia Presbyterian Medical Center
640 W. 168th Street
New York, NY 10032

United Cerebral Palsy Assoc., Inc.
66 E. 34th Street
New York, NY 10016
212-481-6300

I N D E X

	Page
A	
Accident background	67-88
Accident site	79,80
Accident data collection	7-9
Alcohol	8,74-76
Ankle joint motion	41
Anthropometric data collection	2,3
Anthropometry	12, 27-38
Anthropometry glossary	15-24
B	
Bathroom design	92-94
Biomechanics	12,39-65
Biomechanics glossary	15-24
Blindness	107
Burns	9
Burn hazards	87
Burns, pre-existing pathological conditions	88
C	
Cerebral palsy	106
Child care time	11,113
Clothing care time	118
Crawling height	31
Crawling length	32
D	
Deafness	100,101,107
Design checklists, housing	89-94
Design recommendation, housing	89-96
Dexterity, measurement	4,5
Disability	9,13,98-107
Disability organizations	10,102-107
Door design	91,92
Drug use	8,77,78

	Page
E	
Elbow Crutch utilization	35
Elbow joint range	41
Elbow rest height	28
Epilepsy	104,105
Equipment utilization, household	11,116-118
Exercise level	70
F	
Falls, causes	85
Falls, processes	84
Fire mortality	86
Fixture design, household	81,82
Fixture spacing, bathroom	93,94
Floor surface design	83
Forearm joint motion	41
Forward arm reach	29
Forward reach, sitting	30
Free time	11,115
Functional arm reach	29
Functional arm reach extended	29
G	
Grasp reach range	4,39
Grip strength	5,6,47
adult female	47
adult male	47
child female	47
child male	47
young child, female	47
young child, male	47
H	
Hand grip joint motion	42
Hand rail design	89,90
Hand arm manipulation	4,43

	Page
Hearing	10
Heating and cooling equipment utilization	116
Height	27,28
adolescent female	27,28
adolescent male	27,28
adult female	27,28
adult male	27,28
child, female	27,28
child, male	27,28
old female	27,28
old male	27,28
young child, female	27,28
young child, male	27,28
Hemophila	105,106
Hip joint motion	41
Home safety	67-96
Home safety data conclusion	12
Household activity	109-122
Household activity data conclusion	12
Household activity time	10,11,112-115
Household data sources	10
Household equipment sources	11
Housewife activity times	109
Housework time variation	11,110,111
Housing and equipment, task difficulty factors	121
I	
Illumination, area	96
Illumination, kitchen	95
J	
Joint motion	4,41,42
K	
Kitchen design	92
Kitchen equipment utilization	117

	Page
Knee joint motion	42
Kneeling height, crouched	31
Kneeling height, upright	31
Kneeling length	32
L	
Lifting, user acceptance	62-65
adult female	62-65
adult male	62-65
Lateral grip reach	30
M	
Maneuvering space, disabled	3
Manipulative dexterity, blind	4,44
Manipulative dexterity, plegies	5,45
Manual force application, safe	57-61
Meal preparation time	112
Motor disability effects	99
Multiple schlerosis	107
Muscular dystrophy	107
Myasthenia gravis	102,103
N	
Neck joint motion	42
Normal home definition	1
O	
One stick utilization	35
Overhead reach, standing, two arms	29
P	
Paraplegia	102
Parkinson's Disease	106

	Page
Passage requirements, normal	34
Personal factors in accidents	67-69
Personal time	11,114
Popliteal height	28
Product quality in accidents	71,72
Prone height	32
Prone length	32
Push-pull	5,6,48-50
adult female	48,49
young child, female	49,50
young child, male	49,50
R	
Reach	29,30
adolescent female	29,30
adolescent male	29,30
adult female	29,30
adult male	29,30
young child, female	29,30
young child, male	29,30
Reach envelope, amputees	4,40
Risk population	98
S	
Shoulder crutches utilization	35
Shoulder joint motion	41
Sitting eye height	27
Sitting height	27
Sitting knee height	27,28
Squatting height	31
Squatting height, minimum	31
Stairs and ramps design	89
Stature	27

	Page
T	
Task cognitive factors	119
Task complexity, difficulty	122
Task difficulty	12,119-122
Thigh clearance height	28
Tobacco use	8,73
Torso breadth, bent	31
Torso height, bent	31
Tripod walker utilization	35
Two stick utilization	35
V	
Vertical reach, sitting	30
Vertical reach, standing	29
W	
Walking	5,46
elderly	46
young adult	46
Walking aid, terrule tip, utilization	35
Walking aid, wheeled, utilization	35
Walking, disabled space requirements	35
Water supply control	93
Wheelchair dimensions	36
Wheelchair and occupant dimensions	33
adult female	33
adult male	33
child female	33
child male	33
Wheelchair maneuvering space	37,38
Whole body force measurement	5,6
Whole body position	31,32
adult female	31,32
adult male	31,32

	Page
Whole body push	51,52
adult female	51,52
adult male	51,52
Window design	90
Work constraint factors	12,120
Wrist joint motion	42

NBS-114A (REV. 9-78)

U.S. DEPT. OF COMM. BIBLIOGRAPHIC DATA SHEET	1. PUBLICATION OR REPORT NO. NBSIR 80-2014 (HEW)	2. Gov't. Accession No.	3. Recipient's Accession No.

4. TITLE AND SUBTITLE

Safe Environments--Anthropometric, Biomechanical, and Activity Considerations

5. Publication Date: June 1980

6. Performing Organization Code

7. AUTHOR(S)

Clarke E. Jones, John V. Fechter

8. Performing Organ. Report No.

9. PERFORMING ORGANIZATION NAME AND ADDRESS

NATIONAL BUREAU OF STANDARDS
DEPARTMENT OF COMMERCE
WASHINGTON, DC 20234

10. Project/Task/Work Unit No.

11. Contract/Grant No.

12. SPONSORING ORGANIZATION NAME AND COMPLETE ADDRESS *(Street, City, State, ZIP)*

13. Type of Report & Period Covered

14. Sponsoring Agency Code

15. SUPPLEMENTARY NOTES

__ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

This report has been prepared for the National Bureau of Standards' Center for Fire Research as part of their support to the Office of Human Development Services of the U.S. Department of Health, Education and Welfare. The major objective of this report is to summarize data describing the physical characteristics of "normal" and disabled people as actual or potential resident's of "normal" homes, the space through which they move, their limits of bodily action, the causes of their injuries, and the factors influencing their use of residential time. The data have been obtained almost entirely from published literature. Specific and general evaluations of the applicability of the data to normal home activities are presented.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)*

Accidents; Anthropometry; Biomechanics; Disability; Disability organizations; Home safety; Household activities; Household design; Mobility aids; Room use

18. AVAILABILITY

[X] Unlimited

__ For Official Distribution. Do Not Release to NTIS

__ Order From Sup. of Doc., U.S. Government Printing Office, Washington, DC 20402, SD Stock No. SN003-003-

[X] Order From National Technical Information Service (NTIS), Springfield, VA. 22161

19. SECURITY CLASS (THIS REPORT)	21. NO. OF PRINTED PAGES
UNCLASSIFIED	155
20. SECURITY CLASS (THIS PAGE)	**22. Price**
UNCLASSIFIED	$11.00

USCOMM-DC